COMPTON'S
PICTURED ENCYCLOPEDIA AND FACT-INDEX

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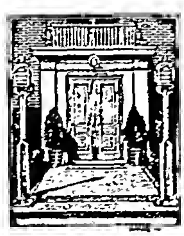
TO INSPIRE AMBITION,
TO STIMULATE THE IMAGINATION, TO PROVIDE THE
INQUIRING MIND WITH ACCURATE
INFORMATION TOLD IN AN INTERESTING
STYLE, AND THUS LEAD INTO
BROADER FIELDS OF KNOWLEDGE,
SUCH IS THE PURPOSE OF
THIS WORK



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COMPTON'S PICTURED ENCYCLOPEDIA

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Here and There in This Volume

At odd times when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit faraway countries, watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study guide. For these purposes consult the Fact-Index and the Reference-Outlines.

Pictures You Will Enjoy

For the Reading Hour

Parent and Child; School and Home

The Story of the Presidents

Marvels of Science and Invention

Some Famous Men and Women

High Lights in History's Pageant

The Story of the States

Travel Views of Lands Across the Seas

The Wonder We Call "Life"

The World at Work

Guideposts to Literature, Art, and Music

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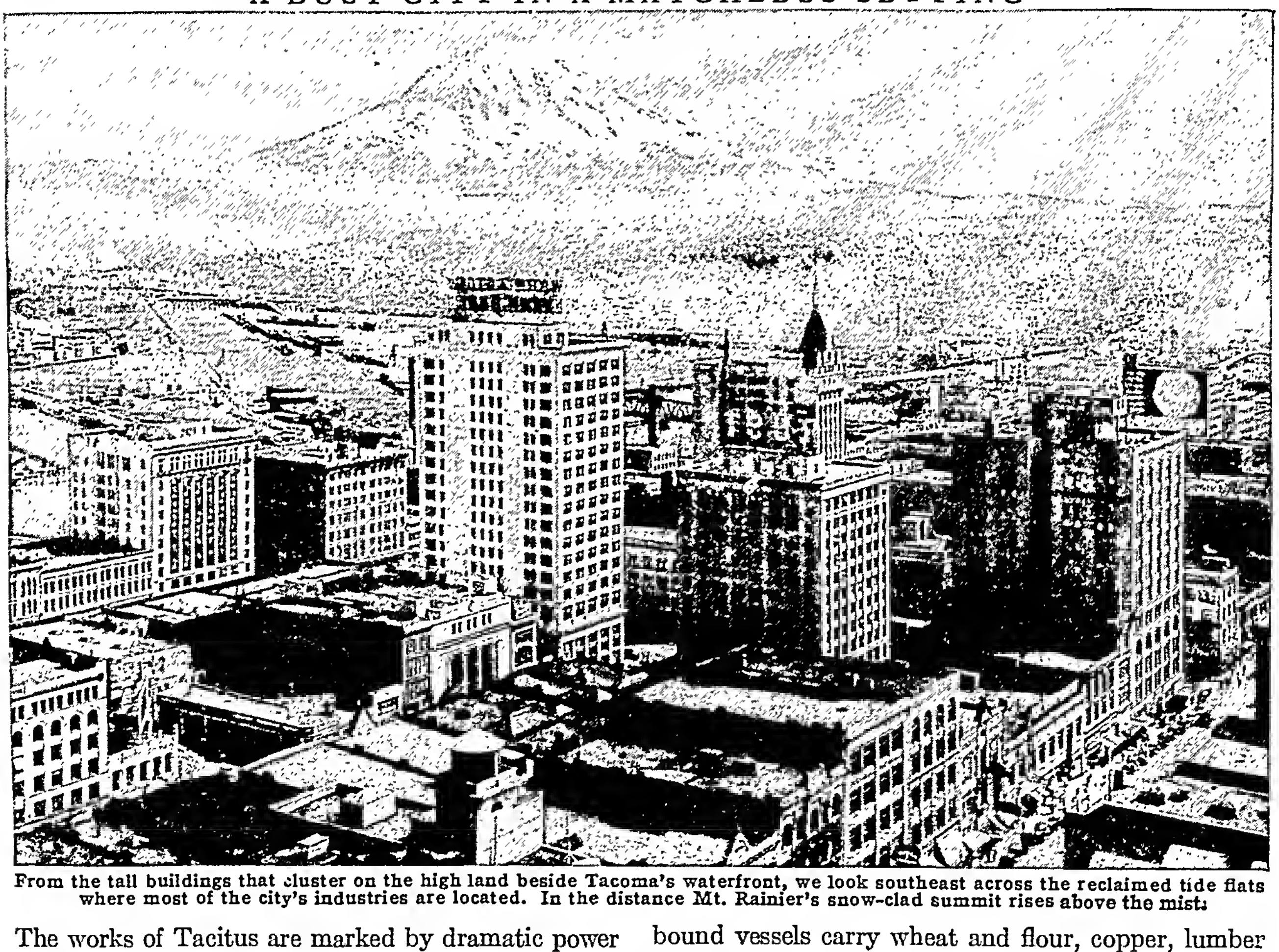
KEY TO PRONUNCIATION

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index. Marked letters are sounded as in the following words: cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, do̤; cūre, bŭt, ru̦de, fu̥ll, bûrn; *out*; ü=French *u*, German *ü*; ġem, ḡo; *th*in, *th*en; ṅ=French nasal (Jeaṅ); *zh*= French *j* (*z* in azure); ᴋ=German guttural *ch*.

T

TACITUS (*tăs'ĭ-tŭs*), CORNELIUS (55?–120?). Whenever we read about the Roman emperors Tiberius, Claudius, or Nero, we can be sure that what we are reading is largely based on the writings of Tacitus. Little is known of this great Roman historian. He was educated to be an orator and became a pleader before the bar and a senator. He held a number of public offices, including that of consul. Agricola, a Roman general and governor of Britain, was his father-in-law and Pliny the Younger his good friend and admirer. From his own writings we know that Tacitus combined a shrewd knowledge of the world with high ideals, proving, as he said of Agricola, "that there may be great men even under bad emperors."

A BUSY CITY IN A MATCHLESS SETTING



From the tall buildings that cluster on the high land beside Tacoma's waterfront, we look southeast across the reclaimed tide flats where most of the city's industries are located. In the distance Mt. Rainier's snow-clad summit rises above the mist.

The works of Tacitus are marked by dramatic power and masterly characterization. Of the major works, the 'Annals' deals with the three emperors named. Only 12 of the original 18 books survive and the discussions of Claudius and Nero are incomplete. The 'Histories', in 12 books, covered the period between the death of Nero and that of Domitian, but about two-thirds of this work has been lost. What remains deals with the year 69, when Rome had four emperors, and with the following year, the first of Vespasian's reign. The three minor works of Tacitus have been preserved entire. Of these, 'Agricola', a biography, includes an account of the conquest of Britain and a somber description of the reign of terror under Domitian; 'Germania' contains invaluable information on German tribal customs; and 'A Dialogue on Oratory' sheds light on Roman culture. (*See* Latin Literature.)

TACOMA, WASH. Standing near the southern end of Puget Sound, 150 miles from the Pacific Ocean, Tacoma is superbly located for world trade. Ships from the ports of the United States and many other nations use its harbor on Commencement Bay. Outward-bound vessels carry wheat and flour, copper, lumber and furniture, and other goods. Inbound cargoes include logs and lumber, copper and other ores, gasoline and fuel oil, and canned goods.

Tacoma's many lumber and pulp mills and furniture and wood products factories have earned it the name "forest products capital of America." The mills get timber from the Cascade Mountains and other forested areas of Washington State, the second largest lumber

producer among all the states. The city also has one of the greatest copper smelters in the nation, a huge aluminum reduction plant, and a number of electrochemical plants. Wheat from the western part of Washington's grain region is brought to the city for milling and export. Two of the four transcontinental railroads which serve Tacoma have their western car-building and repair shops here.

From the waterfront, the city rises to a plateau some 200 feet high and then mounts into the hills. From its heights Tacoma looks west over the bay to the Olympic Mountains and east to the Cascades. To the southeast looms snow-capped Mount Rainier, "the mountain that was God" to the Indians. It is in Mount Rainier National Park, about 50 miles from Tacoma.

On the city's plateau and along the shores of four fresh-water lakes near by are beautiful homes with fine grounds. Roadways and trails wind through the virgin woods of Point Defiance Park. The park has a zoo, an aquarium, and a reproduction of old Fort Nisqually. Wright Park has 300 different kinds of trees.

The College of Puget Sound is in Tacoma, and the Pacific Lutheran College is in the town of Parkland to the south. Washington State Historical Society Museum has Indian handicraft and pioneer equipment.

Power is supplied at low rates by hydroelectric plants owned by the city in the Cascade and Olympic mountains and by the federal government on the Columbia River. Tacoma adopted the city-manager form of government in 1952; it owns a belt-line railroad. With Seattle it shares a large airport.

In the city is Tacoma Naval Station, a navy reserve fleet and repair installation. McChord Air Force Base is ten miles south of Tacoma. Farther south is Mount Rainier Ordnance Base, where army equipment is stored and repaired. To the south also is Fort Lewis, a 110,000-acre army post.

In 1940 the Tacoma Narrows Bridge, the world's third longest suspension bridge, was completed over Puget Sound but was soon wrecked by a gale. In 1950 a four-lane $18,000,000 span replaced it.

George Vancouver visited the site of Tacoma in 1792. The Hudson's Bay Company built a fort at Nisqually, a few miles away, in 1833. In 1841 Charles Wilkes began a survey of Puget Sound at Commencement Bay and gave the bay its name. The city was organized in 1884 by consolidating Old Tacoma, laid out in 1868 by Gen. M. M. McCarver, and New Tacoma, established by the Northern Pacific Railroad in 1873. Population (1950 census), 143,673.

PRESIDENT TAFT *and His* ADMINISTRATION

TAFT, WILLIAM HOWARD (1857–1930). No man ever came to the White House better prepared for his task than William Howard Taft, 27th president of the United States; and no ex-president ever performed greater service to the people after leaving office.

Unlike many of the presidents, Taft was a trained public executive. For nearly 30 years he had been learning the art of government in disinterested devotion to the public welfare. Yet he was unfortunate in the four years that he served as president, and the substantial work that he accomplished was partly hidden by the quarrels that split the Republican party.


WILLIAM HOWARD TAFT

Taft came from a Cincinnati family of means and high social position. His father, Alphonso Taft, had been attorney general in Grant's Cabinet, and then minister to Austria and to Russia. At graduation from Yale in 1878 young Taft stood second in his class and two years later, graduating from the law school at Cincinnati, he and another shared first place.

Taft's capacity for hard work brought quick recognition. Before he was 30 he had been assistant prosecuting attorney of Hamilton County, collector of internal revenue, and assistant solicitor of Hamilton County. He then served three years as judge of the state superior court, resigning to become solicitor general of the United States. Between 1892 and 1900, as judge of the federal appellate court, he established a national reputation by decisions involving trusts, railroads, and labor unions. In 1900 President McKinley, needing a strong, patient, brave man to form a civil government in the Philippine Islands after the insurrection under Aguinaldo should die out, sent Taft to Manila. There, July 4, 1901, he received his appointment as first civil governor of the islands.

Taft was opposed to the retention of the Philippines by the United States, and took up their government with a deep sympathy and love of justice that soon endeared him to the native population. In 1904, President Theodore Roosevelt called Taft to Washington to succeed Elihu Root as secretary of war.

This change left Taft still indirectly responsible for the Filipinos, for the government of the island possessions was supervised by the War Department. In 1907 he went back to Manila to open the first legislature. He also served for a short time as gover-

nor of Cuba when an insurrection caused American intervention. By now Taft was "handy man" for the President, for Roosevelt soon learned that whatever task was assigned to Taft would be done well. Sometimes he was called the "traveling secretary," because he was so often sent to represent the President; or he was delegated to "sit on the lid" when Roosevelt himself was out of Washington. He explained the "Roosevelt policies," and gave them enthusiastic support, for his mind, though legal, leaned to the progressive view that law is made for man, not man for the law.

Taft Elected President

When the time came to select a successor who might in the next administration carry these Roosevelt policies into effect, Taft was the choice of Roosevelt (*see* Roosevelt, Theodore). He was easily elected president in 1908, over William J. Bryan, who was now for the third time defeated; and in 1909, with James S. Sherman as vice-president, he began a term that was doomed to trouble. Roosevelt had managed to keep the Republican party from an open split. But lines beneath the surface were sharply drawn between the "stalwart," or "standpat," faction, who wanted no change in public policies, and the younger politicians, who hoped to use the full strength of the government to curb the trusts and the railroads. Roosevelt, generally siding with the progressive faction, left office deeply hated by the stalwarts; but he had kept both factions from open rebellion. Taft proved to be unable to control them and disappointed both. He was too progressive ever to receive full support from the stalwarts; and he was too judicial for the liberals and radicals who thought themselves progressive. He lacked the art of creating enthusiasm or inspiring a public following. He became president with doubts in his own mind, for he thought himself best fitted for the bench, and had long cherished the ambition to be chief justice of the Supreme Court.

When Taft became president, the Republican party had for 12 years been in complete control of the national government; and for most of that time the United States had enjoyed an unusual degree of prosperity. The rich were everywhere getting richer. Business was arrogant, insisting on its rights and expecting the government to protect it. The farmers, beginning to want automobiles and the new mechanical conveniences, thought the government was too much under the influence of "Wall Street." For several years a group of radical newspapers had been engaged in showing up the sins of big business—"muck-raking," it was called. Labor was providing for itself a better organization through its unions and was striving for laws in its behalf. Immigrants were coming into the United States to compete for jobs at the rate of about 1,000,000 a year. Labor wanted immigration restricted and the courts forbidden to issue injunctions to break up strikes. It had been well disposed toward Roosevelt, who preached the "fair deal" to all; but it mistrusted Taft because he, while federal judge, had given decisions restricting labor and in one important case had granted an injunction against a group of railroad employees, who had gone on strike.

TAFT'S ADMINISTRATION 1909–1913

- American Occupation of Cuba ended (1909).
- Dispute with Venezuela arbitrated (1909).
- Payne-Aldrich Tariff passed (1909).
- Rules of House of Representatives reformed (1910).
- Postal Savings Bank created (1910).
- Publication of Campaign Expenses in Federal Elections required (1910).
- Democratic Majority elected to the House (1910).
- Standard Oil Company and Tobacco Trust dissolved by Supreme Court (1911).
- Canadian Reciprocity Treaty (not ratified by Canada).
- Bills for Tariff Reductions vetoed (1911).
- Parcel Post established (1912)
- Panama Canal Tolls Bill passed (1912).
- Territorial Government set up in Alaska (1912).
- New Mexico and Arizona admitted (1912).
- Arbitration Treaties with France and Great Britain (1912).
- *16th Amendment adopted, giving* Congress Power to levy Income Taxes (1913).
- Department of Labor created (1913); Children's Bureau (1912).
- Nonintervention in Mexican Revolutions (1910–1913).
- Taft renominated; Progressives nominate Theodore Roosevelt; Wilson elected (1912).

Tariff Revision

The first task before the Taft administration was a revision of the tariff, which had been under discussion since 1900 (*see* Tariff). The West wanted a set of lower rates; the manufacturing East wanted full protection. The new congress was organized with "standpat" Republicans in control. The new Payne-Aldrich tariff, completed in August 1909, left the tariff schedules about as high as before, and even raised some important duties. It seemed a clear violation of the party platform promising revision downward. As a result, the more progressive western Republican leaders were in open revolt, charging that Taft had abandoned the Roosevelt policies.

A difference of opinion respecting conservation became a political issue soon after the Payne-Aldrich tariff was enacted. Roosevelt had been an ardent and vociferous supporter of the conservation of natural resources (*see* Conservation). Charges were now heard that the new secretary of the interior, Richard A. Ballinger, was favoring the coal companies, the mining companies, and the timber interests that were exploiting the public lands of the West. The problem was difficult and technical, because most of the laws were based on the assumption that the lands were to be used for ordinary farms; and there was inadequate provision for mining, lumber

and water-power development. A quarrel involving Ballinger, representing the public land interests, and Gifford Pinchot, the forester of the United States became an open scandal, requiring Taft to intervene. He upheld Ballinger, who was Pinchot's superior, and dismissed Pinchot; whereupon the western Republicans, now called Insurgents, attacked Taft as the agent of big business and as a traitor to the cause of conservation. An investigation by Congress upheld the President; the Insurgents called it "whitewashing" Ballinger.

The split between the two Republican factions was so bitter that in March 1910 the insurgent Republicans combined with the Democrats to change the rules of procedure in the House of Representatives. Under the old rules the Insurgents were regularly suppressed by the speaker, Joseph G. Cannon, who was considered an ally of President Taft. He generally refused recognition to Insurgents when they arose to speak unless they had previously obtained his consent; he appointed all committees, and was the leading member of the committee on rules, which controlled the course of legislation. Under the new rules the speaker was ineligible for membership on the rules committee, and the House selected its own committees. In the fall elections of 1910 the Democrats won a majority in the House.

THE FORTY-EIGHTH STATE JOINS THE UNION

With a stroke of President Taft's pen, Arizona—the last territory within the boundaries of the United States—became a state on Feb. 14, 1912. The signing of the proclamation added the forty-eighth star to the American flag. On this day for the first time motion-picture photographers set up their cameras in the White House to make a record of the event.

The Administration's Many Accomplishments

The noisy quarrels and Taft's inability to rise above them and dominate the situation obscured many achievements. The Panama Canal was nearly finished, and a law was passed for the government of the Canal Zone. Alaska was made a territory in 1912, and Arizona and New Mexico were admitted as states. The Interstate Commerce Commission was given additional powers, and a Bureau of Mines was created. Two new amendments to the Constitution were adopted by Congress, and submitted to the states for ratification. The 16th gave Congress the power to levy a tax on incomes; and after its adoption in 1913 the United States ceased to rely upon the tariff as its chief source of revenue (*see* Taxation). The 17th removed a common cause of corruption from state legislatures by providing that United States senators should be elected by direct vote of the people. A postal savings system was established in 1910, and the parcel post in 1912 (*see* Post Office). Also in 1912 the Children's Bureau was created in the Department of Commerce and Labor; and in the next year this department was divided into two, both heads being made members of the Cabinet (*see* United States Government). Treaties for general arbitration with England and France were negotiated, but were lost because of disapproval in the Senate. Taft believed in obligatory arbitration of international disputes. An agreement for reciprocity with Canada, reducing the tariffs to give special advantages to both countries, was lost because Canada rejected it as an issue in 1911 (*see* Laurier, Sir Wilfrid).

The Republican factions, quarreling in 1909 and 1910, lost control of Congress in 1911, and in 1912 disputed over the presidential succession. The Insurgents, now better organized, called themselves Progressives, and made every effort to prevent Taft's renomination. They had no leader, however, whose name and fame were powerful enough to promise success. Best known among them was Robert M. La Follette of Wisconsin, who as governor and senator had urged laws to control the trusts and corporations, and had fought the policies of Taft. More prominent as a Progressive, and more useful as a leader, was Theodore Roosevelt, for whom there was a hope of victory if only he could be persuaded to run. Because he was a sponsor for Taft and had taken no sides in the party quarrels after 1911, his candidacy was uncertain. But early in 1912, when the health of La Follette weakened, his supporters turned to Roosevelt, who came out for "new nationalism" and the nomination.

Roosevelt found most of his old associates lined up with Taft, and although he made a stirring fight a majority of the delegates to the convention were pledged to Taft. The Progressives attacked the convention as a corrupt system, urging the "direct primary" for making nominations; and in states where a direct primary existed the vote showed that Roosevelt's popularity was greater than that of Taft. But Taft was renominated. The Roosevelt supporters left the Republican party, organized the Progressive

party, nominated Roosevelt and Hiram Johnson, and entered the campaign fighting for Roosevelt's old slogan of "social justice." Taft was defeated, carrying only Vermont and Utah. Roosevelt had many more popular votes than Taft, but the split defeated both factions, and the Democrats won with a minority of the popular vote (*see* Wilson, Woodrow).

Taft Advocates Peace League

Taft lived for most of his life on the moderate income of a public officer. He had no great wealth when he left the presidency, and he felt obliged to work. Though he was lawyer and judge by training, he had no connections at the bar. He felt, moreover, that it would be wrong for him to appear as a lawyer before judges whom he had himself appointed while president. He lectured for a while, and soon moved to New Haven, Conn., to be professor of law in Yale University. The bitterness of the fight of 1912 faded away, and gradually the ex-president's views on public questions became welcome and respected. In particular, his views on peace and the use of arbitration as a means of preventing wars agreed with the spirit of the time. The United States was about to celebrate a century of unbroken peace with England. Andrew Carnegie was building a palace for the court of arbitration at The Hague and launching his Endowment for International Peace in Washington.

The outbreak of the first World War in 1914 found Taft free from the responsibilities of government and identified with the movement for world peace. Whereas Roosevelt in the next two years preached preparedness, Taft devoted his strength and influence to the promotion of a league to enforce peace, which might be created after the war and be able to prevent another war. President Wilson endorsed the movement in 1916, and in 1917 made its proposal the center of his own policy for ending the first World War. The League of Nations that was incorporated in the Treaty of Versailles in 1919 owed much to the advocacy of Taft.

Taft continued his work for peace after the United States entered the war, but more definite duty was found for him in war work. In 1918 it was necessary to create a National War Labor Board. At first the production of tools of war, of ships, and of clothing for the men was much delayed by disputes over working conditions and the rate of wages. The National War Labor Board became a supreme court for labor disputes, and Taft became one of its two joint chairmen.

The last public service of the ex-president began when President Harding in 1921 named him to the post he had long coveted, chief justice of the Supreme Court to succeed Edward D. White. He was never regarded as one of the greatest lawyers to sit upon the Supreme Court, but he was sound and wise. Those who had in 1912 deserted him, thinking him standpat and reactionary, were agreeably surprised at the liberality and progressive quality of his decisions. On Feb. 3, 1930, he resigned the chief justiceship because of a heart ailment. Death came to him in Washington on March 8. He was buried in Arlington National Cemetery.

TAHITI (*tä-hē'tē*). For many people the beautiful tropical island of Tahiti represents the "romantic" life in the South Seas. It has been called "a paradise of the Pacific." This towering green island has attracted artists, writers, and others seeking to escape the hurly-burly of civilization. The most famous was Paul Gauguin, the French artist, who painted the handsome, friendly natives. The American novelists, James Norman Hall and Charles Nordhoff, wrote here of adventure in the exotic South Seas.

Tahiti is the largest of the Society Islands, which are owned by France. It rises from the warm south Pacific 2,381 nautical miles southeast of Honolulu and 3,663 nautical miles southwest of San Francisco. The island's chief town is Papeete. It is the administrative center for French Oceania.

Dense tropical vegetation clothes the rugged, volcanic mountains that rise to 7,339 feet in Mount Orohena's double peak. Their summits are wreathed in mist and frothy waterfalls tumble down their steep shores. A fertile coastal plain and a sand beach rim the mountain core. Shaped like a figure eight, the island is 33 miles long and about 16 miles at its widest point.

The climate is pleasing. The temperature rarely rises above 94° F. even in the summer months of February and March. Throughout the year the daytime average is 85° and night temperatures vary between 83° and 60°. Rainfall is abundant.

In this warm climate, the easy-going Polynesian natives do not have to work hard to live. The volcanic soil yields bountiful quantities of breadfruit, coconuts, bananas, other tropical fruits, and vegetables. Fish are abundant among the coral reefs. The natives

MAIN STREET IN PAPEETE

Awnings are down and few people are on the streets in the heat of the day in this tropical town. Notice the Chinese at the left. Much of the island's retail business is in Chinese hands.

dive for pearl oysters from their outrigger canoes, and many hull and dry coconuts to make copra (*see also* Pacific Ocean). The French have developed phosphate mines and plantations for sugar, coconut, and vanilla. They imported Chinese to do much of the hard work. The chief exports are copra, mother-of-pearl, vanilla, sugar, rum, and phosphates.

TAHITI'S CHIEF TOWN AND ITS PEACEFUL HARBOR

In this view of Papeete from the mountains at the heart of the island, only the roofs and spires of the buildings are visible amid the dense tropical foliage. The quiet harbor is sheltered by the barrier reef around the island. A channel through it allows the ships to enter.

Papeete has 12,428 of the island's 29,684 people (1946 census). The other inhabitants live in small communities of thatched houses along the coastal plain. Many villagers still wear the traditional vividly colored costumes and, on festive occasions, wreaths of flowers. The mountains are not inhabited. Of the nonnatives, 2,167 are French, and 4,655 are Chinese.

Though a Spanish ship probably touched Tahiti in 1606, credit for its discovery has gone to an Englishman, Capt. Samuel Wallis, who charted and took possession of the island in 1767. The French claimed it the next year when Louis de Bougainville came ashore. In 1769, Capt. James Cook brought scientists of the British Royal Society here to observe the transit of Venus across the face of the sun. This visit gave the Society Islands their name. The French gained control of Tahiti in the 1840's and it was made a French colony in 1880.

TAILORBIRD. Without needle, thimble, or even hands, this little bird of Asia is an expert seamstress. She uses her bill as a needle, with thread if she can find it; if not, with bits of fiber or grass; and she sews leaf edges together into a wonderful sack. This she fills with wool, fibers, and hair to make a soft nest for her young. Tailorbirds are singers. They are small, with olive-green plumage above, and yellowish white beneath. The head is marked with a touch of chestnut. They are natives of India, Ceylon, southern China, and the Philippines. Scientific name, *Sutoria sutoria*.

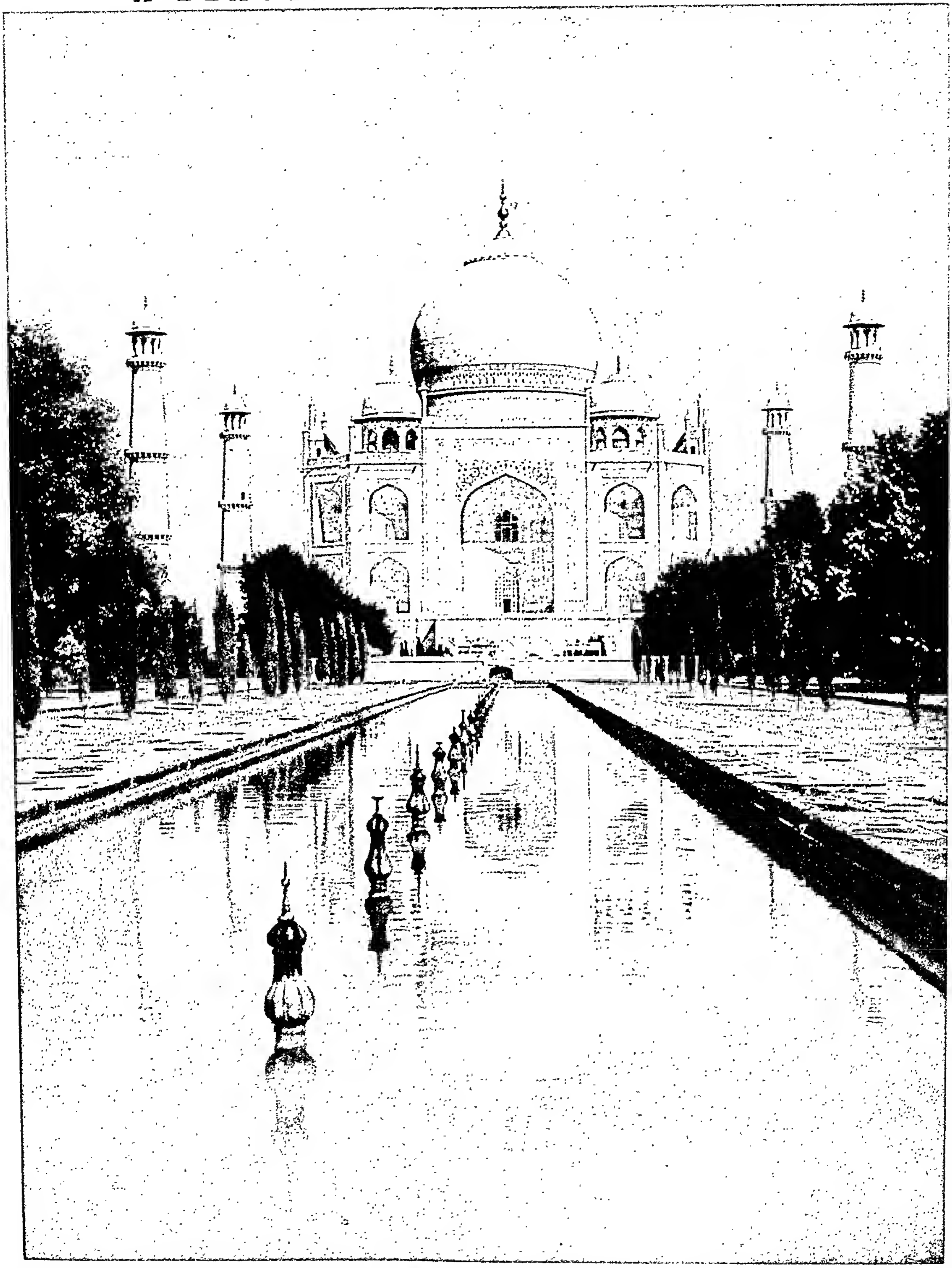
TAJ MAHAL (*täg mä-häl'*). The Taj Mahal, one of the most beautiful buildings in the world, was built by the Mogul emperor Shah Jehan at Agra, near Delhi, India, as a tomb for his favorite wife. When the Moguls came to India in the early 16th century they brought their Persian civilization with them. Persian was the court language, while the arts, especially gardening, were truly Persian. Thus it is natural to find the Hindu architects and artisans building in the Persian style for their conquerors. For its erection a vast army of Hindu workmen labored constantly for 22 years, and the Taj, with its neighboring palace and mosque, is estimated to have cost between $20,000,000 and $50,000,000.

A beautiful story, preserved in the pages of a Persian manuscript, tells how the plans for the Taj Mahal were drawn from a dream which the empress had and which she described to her husband. He sought throughout all India for an architect who could draw plans from her description, but in vain. Then one day an old religious man appeared before the emperor and said, "I can help you to obtain what you seek." To one of the architects he offered a mysterious drug, saying, "Drink!" And lo! before dazed eyes the wondrous monument was revealed in all its glory. Feverishly the architect worked, under the spell of the magic drug, until the plan was finished to its last detail. Then he fell back exhausted.

Whether this story be true or not, the Taj Mahal is a monument of wondrous beauty. It is of white marble, 130 feet long and wide and nearly 200 feet high to the top of the huge dome, which grandly lifts itself from the eight-sided building. This is flanked on each side by two slender minarets, the whole fabric standing on a platform of red sandstone overlooking the river Jumna. It is surrounded by Persian gardens, such as the Mogul emperors laid out in their summer capital in Kashmir. One of the most interesting sights in India, next to viewing the snow-clad Himalayas on a clear day, is to see the Taj Mahal under the brilliant Indian moonlight, when it resembles a fairy citadel.

Inside, under the great echoing dome, are the cenotaphs or false tombs of Shah Jehan and his empress. The sunlight filters into this chamber, through marble screens intricately wrought and as delicate as lace, lighting up the jeweled cenotaphs. Everywhere the walls of the interior are covered with the floral designs loved by the Persians, picked

A BEAUTIFUL DREAM IN MARBLE



Whether or not the Taj Mahal was planned from a dream of the empress in whose memory it was erected, it is not only the most beautiful tomb in all the world, but one of the world's most famous works of architecture. Its name means "gem of buildings" and like a precious jewel it has an exquisite setting. Stately gardens surround it and quiet pools reflect the pure beauty of its majestic dome and slender minarets. Historians differ as to the exact year but agree that it was built in the 17th century.

out in onyx, jasper, carnelian, and other semiprecious stones set into the white marble walls. Inscriptions from the Koran, the sacred book of the Mohammedans, are carved in Arabic characters. The real tombs of the royal pair are side by side in the vaulted chamber below and devoid of ornament.

TALC. Although the most familiar form of talc is the talcum powder that soothes tender skins, the mineral's chief uses are industrial. Three quarters of the talc processed in the United States goes into the manufacture of paint, glazed tiles and other ceramic products, roofing, paper, and rubber. Toilet powders and other cosmetics account for a relatively small amount.

Talc ($H_2Mg_3[SiO_3]_4$) is a hydrous magnesium silicate. One of the softest minerals, it stands at the bottom of the standard scale for measuring the relative hardness of materials (*see* Minerals). Pure talc breaks easily into thin transparent flakes which are gray, silvery, or greenish white, with a pearly luster. It hardens a little on exposure to the air, is not harmed by high degrees of heat, and holds heat well.

Deposits of talc occur in varying degrees of purity all over the world. They take the form of a soft, grayish stone that feels greasy and is called steatite, soapstone, potstone, and French chalk (tailor's chalk). The pipestone out of which the American Indians made the bowls of their tobacco pipes is a form of talc. Many primitive peoples have shaped this mineral into cooking vessels. The Egyptians carved it into scarabs and other amulets, which they coated with a colored glaze. The Chinese use it widely in ornamental carvings. Pyrophyllite, a hydrous aluminum silicate, is similar to talc stones and has much the same uses. It is frequently confused with them.

Most of the talc used industrially is first pulverized. Solid slabs of the stone, however, make laundry tubs, laboratory tables, switchboard bases, and other products in which its resistance to heat and acids is advantageous.

The United States is the largest producer and consumer of talc. Chief producing states are New York, North Carolina, Vermont, California, and Georgia. Talc imported into this country is chiefly the pure, high grade, flaky powder used in cosmetics and other quality products. Italy, Canada, France, China, Japan, and India are leading foreign sources.

TALLAHASSEE, FLA. When Hernando de Soto passed through the Apalachee country of northern Florida in 1539, the Indians' name for their chief village was Tallahassee, meaning "old town." This Indian word was given to the wilderness site selected in 1824 as the capital for the Florida Territory; the city continued as capital when Florida became a state in 1845.

Tallahassee is situated on wooded hills about midway between Pensacola and Jacksonville. The three highest hills are occupied by the Capitol, a coeducational university for whites, and a coeducational college for Negroes. The Capitol Building, in the city's center, was contracted for in 1840; it has been added to since (for picture, *see* Florida). Florida State University, established in 1857, has an 80-acre campus in the western part of the city; Florida Agricultural and Mechanical College for Negroes, opened as a teachers' school in 1887, has a 375-acre campus in the city's southern section. Of interest also are the Governor's Mansion, built in the northern part of the city in 1908, and the Killearn Gardens, about five miles north of the city.

Tallahassee is a political and educational center, but it has wood manufactures and some other industries. It is also a trade center for a fertile farming area. Before the Civil War, the city was a cotton-marketing center. In 1834 the state's first railroad (powered by mules during its first years) was constructed from Tallahassee to St. Marks, a port on Apalachee Bay. Tallahassee was the only Southern capital not taken by Union troops during the Civil War.

Tallahassee was incorporated as a city in 1825. It has the city-manager form of government and owns its own electric and gas manufacturing and distributing systems and a slaughterhouse. Population (1950 census), 27,237.

TALLEYRAND-PÉRIGORD, PRINCE CHARLES MAURICE DE (1754–1838). From the beginning of the French Revolution (1789) to 1834 Talleyrand was an important figure in the French government. France had six revolutionary changes of government during this period. Talleyrand was often out of favor because of his lies, intrigues, and his eager reach for bribes and graft. His brilliance and abilities made the rulers call him back to power.

A descendant of one of France's first families, he was born in Paris Feb. 2, 1754. When he was about four years old he suffered an accident that made him lame for life. A military career was impossible so his father made him study for the priesthood. He was ordained in 1778 and consecrated a bishop in 1789. Selected by his clergy as their representative to the Estates-General (called to relieve the government of its growing debt), he advocated secularization of church property. This and his endorsement of a French national church led the pope to excommunicate him in 1791.

As a semiofficial diplomat he visited London. During the Reign of Terror (*see* French Revolution) he was out of favor in France and unwelcome in England; he went to the United States in 1794. He returned to France in 1796, after the establishment of the Directory, and became foreign minister. It was about this time that he demanded a bribe of the United States (*see* 'XYZ' Affair). His foresight led him to aid Napoleon, and after Napoleon came to power Talleyrand again became foreign minister. It was his intrigues rather than his solicitation of bribes and graft that caused Napoleon to dismiss him as foreign minister in 1807. Napoleon castigated him publicly, but though thereafter Talleyrand worked against the emperor, Napoleon often sought his advice and aid. After Napoleon's defeat (1814), Talleyrand became foreign minister for King Louis XVIII for a

time, but was dismissed. After helping Louis Philippe to become king when Louis' successor Charles X was forced from the throne, Talleyrand greatly influenced European affairs in his post of ambassador to England.

Talleyrand married in 1802, but left no legitimate heirs. Just before his death in Paris (May 17, 1838), he was taken back into the Roman Catholic church after confessing his errors.

TAMARIND. The rare beauty of the tamarind, as well as the commercial value of its pods, leaves, and timber, has led to its extensive cultivation in the tropics. The tree reaches a height of from 70 to 80 feet, has widespreading branches, clothed in light green foliage, and brilliant clusters of purplish or orange-veined flowers.

The curved brown-shelled pods, three to six inches long—also called tamarinds—are filled with an acid juicy pulp. Packed in casks they are shipped from the East and West Indies to European countries, where the pulp is used as a laxative and in making beverages and sherbet. Boiled in sugar they become the preserved tamarinds of commerce. In India the seeds of the pod and the leaves are used in making a red or yellow dye. The tree produces a fine hard wood which is valuable in cabinetwork.

Eastern tropical Africa, from Ethiopia southward to Zambezi, is generally believed to be the original home of the tamarind. It has long been cultivated, however, in many other tropical countries. In the United States it is cultivated most successfully in Florida.

The tamarind belongs to the pulse family, *Leguminosae*. Scientific name, *Tamarindus indica*. Leaves small, pinnate. Fragrant flowers clustered in terminal racemes; 4 sepals, 3 petals, 3 curving stamens.

TAMMANY. Shortly after the close of the Revolutionary War the Tammany Society was organized in New York City as a non-political patriotic and benevolent secret society. The care of widows and orphans of Revolutionary soldiers was one of its main objects. Later it became notorious as a powerful political "machine."

It was founded in 1789 by William Mooney and others. Its name was taken from that of Tammany, a Delaware Indian chief who granted William Penn land in southeastern Pennsylvania. Indian symbols and ceremonies were largely used in its ritual. Its meeting place was leased to a political organization which came to be known as "Tammany Hall," and practically identified with the society itself. In 1800 Tammany first took an active part in a political campaign, being instrumental in carrying New York for Jefferson; and from that time, working within the Democratic party, it exerted a powerful influence on the political history of New York City and State, and even of the United States. When in 1871 the corruption of its "boss" William M. Tweed and his notorious ring was exposed, its reputation suffered severely. In spite of opposition within and without the Democratic party, it continued to wield great power through its strong organization and through the charities, entertainments, and other means by which it appealed to the people.

TAMPA, FLA. Once a year a gaily decorated ship, manned by a crew as picturesque as the buccaneers of the old pirate José Gasparilla, sails into Tampa Bay. Thus Tampa celebrates the Gasparilla Carnival every February to recall the days when pirates had their secret haunts in the harbor.

Tampa lies at the head of Tampa Bay at the outlet of Hillsborough River on the west coast of Florida. This beautiful city grew up from an army post established in 1823, during the war with the Seminole Indians. In 1898 American volunteers for the Spanish-American War sailed from Tampa's harbor to Cuba. Today this city is an outstanding manufacturing and shipping center, and the third largest city in the state. Located 30 miles from the Gulf of Mexico, it is the nearest important harbor to the Panama Canal, Tampa ships carry abroad much lumber, phosphate, and citrus fruit. Its phosphate comes from Hillsborough County, which has one of the largest such deposits in the United States.

Tampa is linked with other cities by rail, truck, bus, and air lines. Gandy Bridge, six miles long, connects the city with St. Petersburg across Tampa Bay.

Tampa makes more hand-made cigars than any city in the world. Its cigar factories are in "Ybor City," named for an early cigar maker. Other large industries are the canning of citrus fruit and the manufacture of cement. The city has a shipbuilding industry and a floating drydock. It is the wholesale center for 18

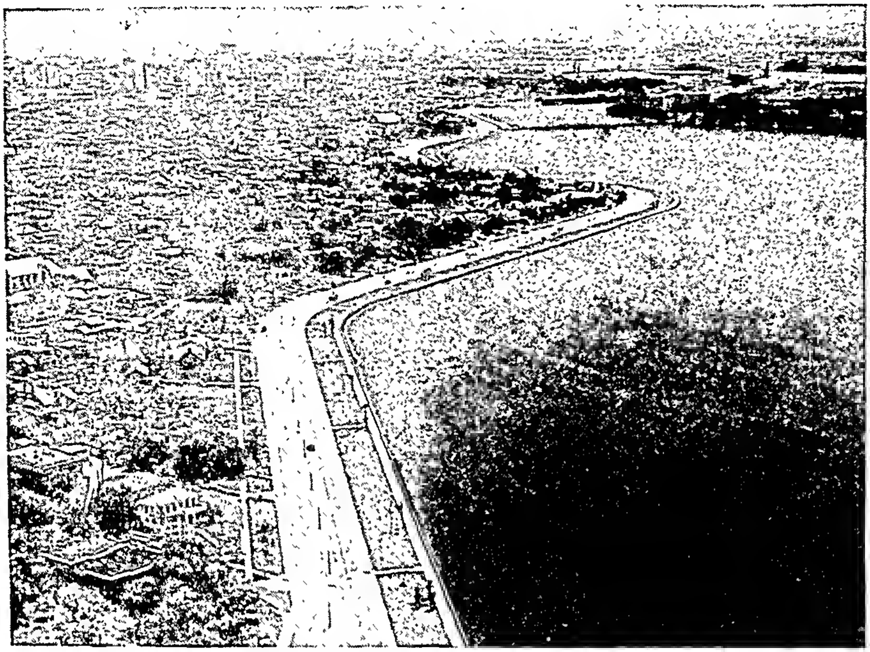
NAST CREATES THE TAMMANY TIGER

The tiger was first used to symbolize Tammany in this cartoon by Thomas Nast. It appeared in *Harper's Weekly* of Nov. 11, 1871. The beast is shown rending the prostrate body of the Republic while "Emperor" Tweed looks on complacently. Nast's cartoons helped to overthrow Boss Tweed.

counties and ships great quantities of vegetables and fruits. The tourist trade is a large source of revenue, as the mild climate attracts many winter visitors.

The city was incorporated in 1885. It is governed by a mayor and council. The University of Tampa, founded in 1931, is surrounded by beautiful Plant Park. Population (1950 census), 124,681.

FAMOUS SEAPORT ON FLORIDA'S WEST COAST



In this view of Tampa we see Bay Shore Boulevard winding beside Hillsborough Bay, an arm of Tampa Bay. The tall buildings of the business district rise at the upper left: At the right is a glimpse of Davis Islands created by pumping sand from the bay.

TANAGER. Few birds are more colorful than the beautiful male scarlet tanager in his dress of red and black. The female, in dull plumage of olive green, is a striking contrast to her handsome mate.

The tanagers are American birds. Most of them live in South America. Five kinds nest north of the Rio Grande. They live in forests, feeding on insects and fruits. They build a saucer-shaped nest on a horizontal tree branch and lay three to five eggs (for picture in color, *see* Egg). The song of the scarlet tanager resembles the robin's, but it is more burred.

Tanagers are about six or seven inches long. The scarlet tanager has a brilliant red body and glossy black wings and tail. (For picture in color, *see* Birds.) It nests throughout temperate North America east of the Rocky Mountains. A more southern bird, east of the Great Plains, is the summer tanager. Its body is dull dark red above and brilliant rose-red below. The head and neck of the western tanager are orange-red; under parts bright yellow; the upper parts black, with yellow rump and wing patches. In the southwestern states, near the Mexican border, are the rare hepatic and Cooper's tanagers. All five species migrate into Mexico and South America in the winter. Scientific name of scarlet tanager, *Piranga erythromelas;* western tanager, *Piranga ludoviciana;* summer tanager, *Piranga rubra.*

TANEY (*tạ'nĭ*), **ROGER BROOKE** (1777–1864). The fifth chief justice of the United States Supreme Court, Roger Taney, succeeded John Marshall in this important post, and continued the work of that renowned jurist in interpreting the Constitution and establishing the powers of the Supreme Court over the constitutionality of national and state laws.

Taney was born in Calvert County, Md., March 17, 1777. He graduated at Dickinson College of Carlisle, Pa., and studied law at Annapolis. He served in the Maryland state senate (1816–21) and was attorney general of Maryland when he was appointed attorney general of the United States by President Jackson in 1831. When, in 1833, President Jackson wished to transfer treasury funds from the Bank of the United States to state banks, he made Taney secretary of the treasury to carry out his plans, and in 1836 he appointed him chief justice. There was strong opposition in the Senate to both nominations and the former was never confirmed.

Among the most important decisions handed down by Chief Justice Taney were those in the Dred Scott case (*see* Dred Scott Decision) and in the Merryman case, the latter denying the right of the president to suspend the writ of *habeas corpus* (*see* Habeas Corpus).

TANGANYIKA (*tăn-găn-yē'kă*), **LAKE.** Its name signifies "meeting place of the waters," and Lake Tanganyika in east-central Africa is one of the largest fresh-water lakes in the world, more than 400 miles long, over 4,000 feet deep, with an area of 12,700 square miles. It stands about 2,700 feet above sea level. The lake separates the British Tanganyika Territory from the Belgian Congo on the west, and its south shore is in Rhodesia, controlled by Great Britain. Burton and Speke discovered Lake Tanganyika in 1858, and Stanley found Livingstone at Ujiji, the principal town on the lake. Near Ujiji is Kigoma, terminus of the railroad which the Germans finished from Dar-es-Salaam, on the Indian Ocean, across German East Africa (now Tanganyika) before the first World War. The scenery about this vast lake is varied and beautiful. Here the typical vegetation of East Africa meets and mingles with the great central forests. The slopes of the surrounding mountains are richly wooded, the principal tree being the *mvule*, from which the natives make dugout canoes. In the clearings along the shore stand the huts of these savages, who cultivate the rice, yams, and sugar cane which thrive in the fertile soil. The people are mostly of the Bantu Negro type.

The lake offers good fishing, and crocodile and hippopotamus live in many inlets. Steamers carry most of the trade between the lake towns. In 1948–49 Britain undertook to clear thousands of acres of virgin bush country and plant sunflowers and peanuts, or groundnuts, for industrial vegetable oil.

TANGIER (*tăn-gēr'*). At the northwestern tip of Africa stands the sun-bright little city of Tangier. From the palm-fringed shore of a shallow blue bay, the city rises on terraced cliffs. Slender minarets rise among white and rose-gray buildings.

Despite its small size, Tangier has commercial and military importance. It shares with Gibraltar, 35 miles across the water, the command of the western entrance to the Mediterranean Sea. It was founded by the Phoenicians, and it is believed to be the oldest city in North Africa. In turn it fell into the hands of Carthage, Spain, England, and the Moors.

To prevent any single nation from controlling Tangier in the 20th century, European powers in 1906 set it up as an international zone. Later agreements expanded this zone to an area of about 144 square miles and guaranteed its neutrality. It was administered jointly by France, England, Spain, and Italy. In the second World War, Spanish troops occupied the zone on the pretext of preserving its neutrality. But in 1945 Spain withdrew at the demand of the United States, Russia, France, and England. They established an international régime. Population of the international zone, 150,000 (1949 est.); about 85,000 are Moors.

TANKS. An ability to smash steadily forward makes the tank one of the most feared weapons in modern battle. A thick armor of steel protects it from hostile small-arms fire. And its *caterpillar tread* enables it to cross rough, shell-churned ground and crush all but the greatest obstacles in its path. The tread is a chain of metal plates that encircles the wheels and provides a continuous track for the wheels to run over. For armament each tank mounts one high-velocity gun in a revolving turret and several machine guns.

Tanks are classified as light, medium, or heavy, according to their weight. Light tanks usually weigh less than 30 tons. They sacrifice some armor and firepower to achieve a road speed of some 30 miles an hour. Medium tanks are less maneuverable but they carry a larger gun and more armor. The extra-thick armor and big gun (90 to 155 mm.) of "heavies" reduce their mobility and make them too heavy for many bridges. Most tanks carry a crew of five or six men.

The British used the first tanks in the battle of the Somme (1916) during the first World War. The name "tank" came from the British use of this term to hide the real purpose of the vehicles while they were being developed. In 1919 Great Britain honored Sir William Tritton and Maj. W. G. Wilson as the men who did the most to make the tank an effective war machine.

During the next 20 years an American inventor, J. Walter Christie, and others greatly improved the speed and striking power of tanks. In the second World War these vehicles knifed deep into enemy territory at motorcar speed, disrupted defenses, and held key points until foot soldiers arrived. Tank units were often organized into armored divisions, supported by infantry and artillery. In 1950 the United States Army established a separate tank branch called *armor* (*see* Army; World War, Second).

The most widely used Allied tank in the second World War was the American M-4, called the General Sherman. It weighed about 35 tons and carried a 75-mm. gun. The German "Panther" and "Tiger" tanks were slower but more heavily armored and gunned. The "Tiger" weighed 60 tons, mounted an 88-mm. gun, and traveled about 20 miles an hour. Late in the war the United States also used a heavier tank, the M-26 (General Pershing).

In 1948 the Army began producing a new medium tank, the M-46 (General Patton). Armed principally with a 90-mm. gun, it travels about 30 miles an hour. This tank proved valuable in Korean fighting beginning in 1950. Here its chief opponent was the Russian-made T-34, a 33-ton vehicle that mounted an 85-mm. gun. Another Russian tank was the huge Josef Stalin III. It weighed about 55 tons and carried a 122-mm. gun.

In 1951 the Army began developing a new series of tanks. First in production was the T-41 (Walker Bulldog), a 26-ton tank that mounted a 76-mm. gun. Meanwhile the Army was experimenting with new medium (T-42) and heavy (T-43) models.

TANNHÄUSER (*tăn'hoi-zẽr*). In an old German legend Tannhäuser was a wandering knight who came to the Venusberg (the mountain of Venus). He entered the luxurious cave palace of Lady Venus and her court. There he gave himself over to revelry and sensual pleasures. But in time he became remorseful. He went on a pilgrimage to Rome and begged the pope to ask God to forgive him. The pope held a wand in his hand and told Tannhäuser that he could no more get God to forgive him than the dry wand could live and grow leaves and blossoms.

In despair the knight went back to Lady Venus in the mountain. Three days afterward the pope's wand began to sprout green leaves. The pope at once sent messengers to every land to call Tannhäuser back, but he could not be found. This story is told in a popular ballad once sung over all Germany. Wagner used it in his opera 'Tannhäuser'. (*See* Opera.)

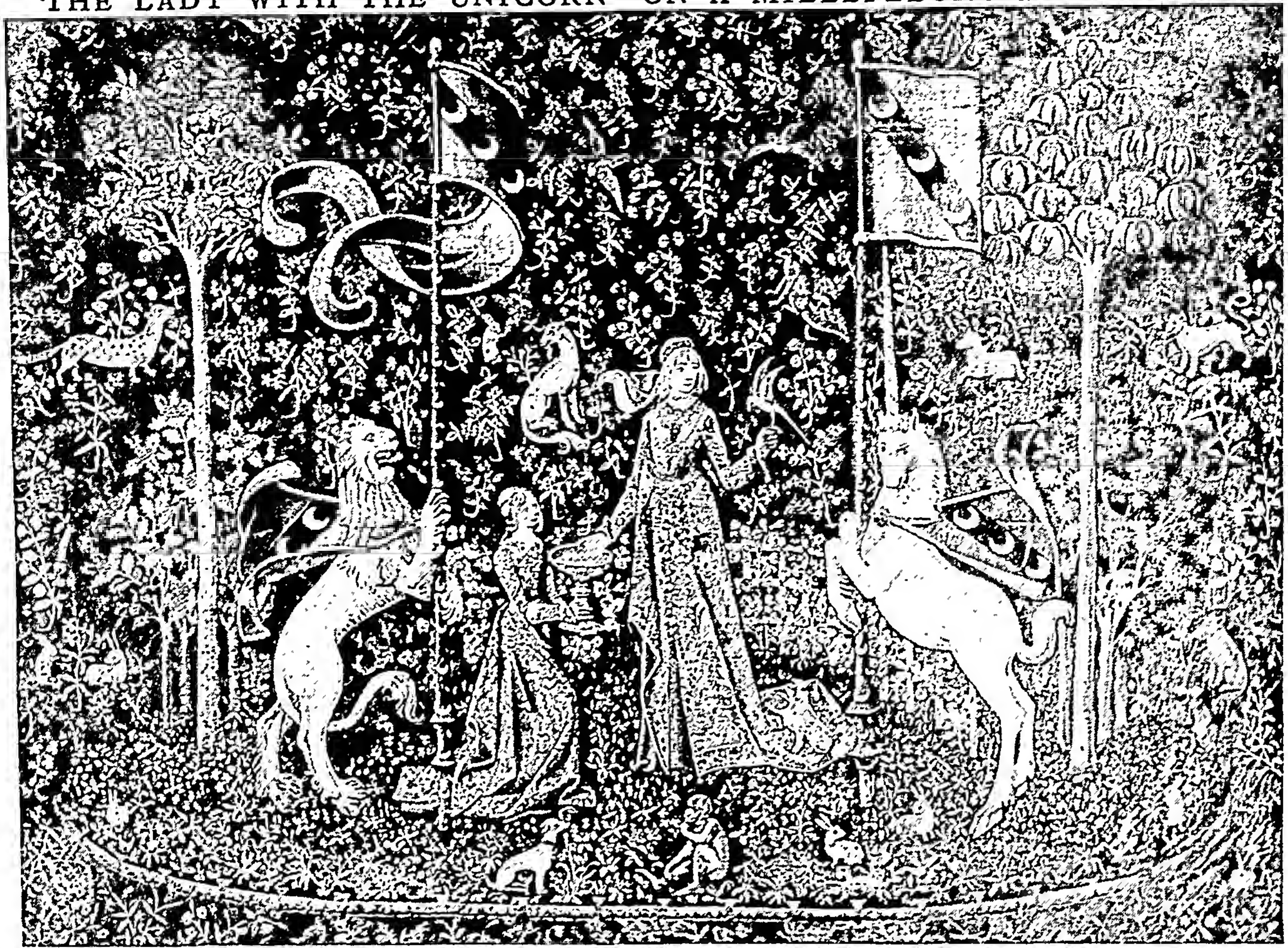
A knight named Tannhäuser actually lived in Germany in the 13th century. He was a minnesinger—a poet who wandered about singing love songs, as was the custom. Because of his adventures, he came to be identified with the knight of the legend.

TAPESTRY. The castles of Medieval and Renaissance Europe would have been cold and gloomy places without their colorful tapestries. Skillful craftsmen wove pictures glowing with life into these hangings, thus bringing warmth and color to bare stone walls. Henry VIII of England is said to have had 2,600 tapestries to hang in his various palaces. The tapestries owned by princes and nobles pictured

THE HUNT OF THE UNICORN IN TAPESTRY

This beautiful tapestry is the first of a series of six which hangs in The Cloisters, a branch of the Metropolitan Museum of Art, in Fort Tryon Park, New York City. It shows the start of the Hunt of the Unicorn. The story is an allegory of the Incarnation, in which the Unicorn, a symbol of purity representing Christ, is hunted and captured. The Unicorn tapestries are among the finest in the world. In richness of detail, range of coloring, delicate design, and pictorial realism, they have no rivals. The flower background of the one shown here is remarkable. Unfortunately nothing is known of their origin. The monogram which appears in the four corners of all the tapestries has not been identified. They are either French or Flemish, and date from the late 15th or early 16th centuries. In 1728 they were hanging in the chateau of Verteuil, France, seat of the La Rochefoucauld family. Removed during the French Revolution, they were later returned to Verteuil and remained there until the 1920's, when John D. Rockefeller, Jr., bought them and gave them to The Cloisters.

'THE LADY WITH THE UNICORN' ON A MILLEFLEURS BACKGROUND



This is one of a set of six tapestries woven in France early in the 16th century. Each shows a lady, a lion, and a unicorn on a deep-blue island against a rose-red ground. Five of the series are probably allegories of the senses. In this one, representing taste, an attendant offers the lady a compote of sweetmeats. The background is in the lovely *millefleurs* (thousand flowers) style. Notice the tiny animals among the flowers. This series hangs in the Cluny Museum in Paris.

events of history and legend, allegories, and scenes of palace and country life. Often they are the best record we have of the dress and customs of the day.

Tapestries were important in the decoration of Gothic cathedrals. One cathedral might have several sets to hang on different occasions. Religious tapestries pictured Biblical scenes or stories, or episodes from the lives of the saints.

Tapestries served other purposes. People hung them from balconies and windows on parade days. Tournament fields were gay with them. On the battlefield they enriched the tents of great warriors.

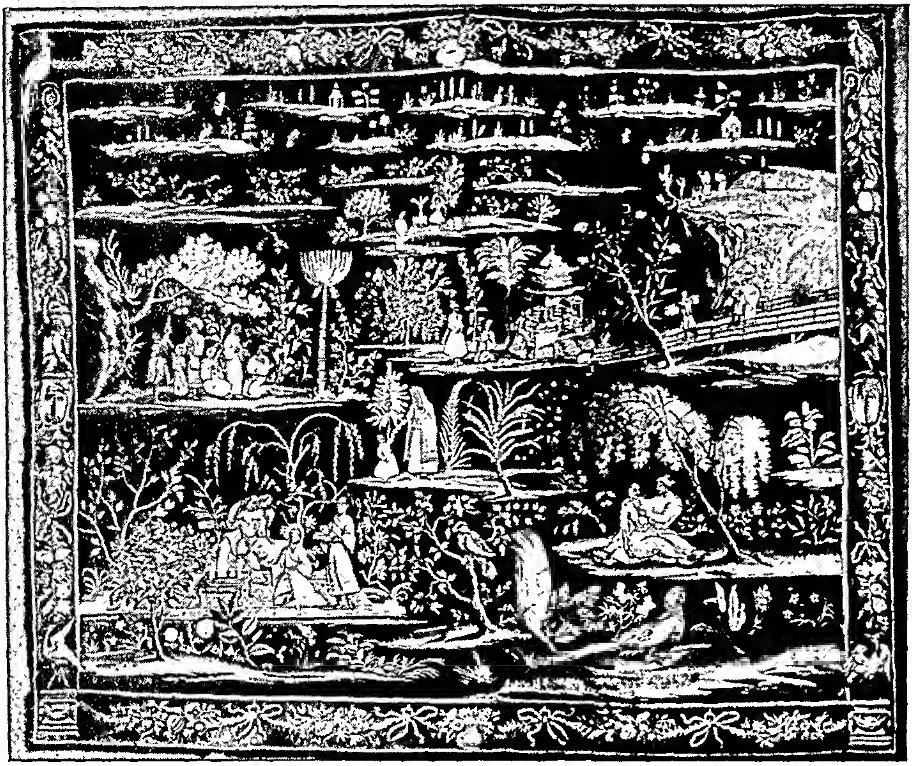
Tapestry making is a special kind of hand weaving. It is usually done with wool alone or with wool and silk. The warp yarns are very heavy. Colored weft yarns, each with its own bobbin, make the design. The weaver laces these in and out among the warp yarns so closely that the latter are hidden except as ridges in the fabric. He carries each color only as far across the warp as the design indicates. The pattern for the tapestry design is a full-size drawing known as a cartoon. If the weaver is working at a "high warp" loom, the pattern hangs on the wall in front of him. In this type of loom, the warp is vertical. A "low warp" loom is horizontal, and the pattern lies below the warp. In this type the warp runs across the fabric.

Weaving by the tapestry method is an ancient art. Fragments of tapestry-woven cloth have been found in ancient Egyptian tombs. The Chinese have made silk tapestries for centuries. But not all wall hangings made of fabric are true tapestries. Some are painted. Many are embroidered. The so-called Bayeux tapestry, depicting the triumphs of William the Conqueror in England, is wool embroidery on canvas.

Craftsmen in the weaving towns of Flanders mastered tapestry making early in the Middle Ages. They carried it to other parts of Europe. Arras, in northeastern France, was the greatest center during the 14th and 15th centuries. So famous did its tapestries become that the English called all tapestries "arras."

Medieval weavers used heavy yarns. The woven texture of the fabric was always evident. Colors were rich but in comparatively few shades. Artists provided drawings done in simplified style, without perspective. During the Renaissance, tapestries became more elaborate. They often had a framelike border decorated with classical motifs. Perspective entered the drawing, and scenes were more realistic. Brussels took the lead in tapestry making in this period.

'THE TOILETTE OF THE PRINCESS' IN OLD TAPESTRY



Made for Elihu Yale in the late 17th century from a Chinese design in London, this fine old tapestry takes for its color scheme the tones of mother-of-pearl on dark lacquer. It is now at Yale University.

Louis XIV consolidated the tapestry workshops of Paris into a great royal factory, the Gobelins, in 1662. He established a smaller factory at Beauvais. A factory at Aubusson, a very old one, flourished again. Among the most famous tapestries the Gobelins made was a series of 14 called 'The History of the King'. These depict events in the life of Louis XIV with life-sized figures and magnificent style.

European tapestries became less grand in the 18th century. Charm and elegance predominated. Weavers worked hard to achieve a smooth, fine-textured effect. Tapestries began to look like painted pictures. This contributed to their decline. By the 19th century they had become uninteresting as an art form. The craft no longer attracted first-rate artists, and the designs deteriorated.

France has had a revival of tapestry weaving as an art in the present century. Leading artists have contributed cartoons. Weavers at the Gobelins and Aubusson factories have carried these out in heavy yarns with comparatively few gradations in color. The best modern tapestries have the texture and brilliance of fine medieval tapestries.

TAPIOCA. The hard white tapioca grains that swell up and become soft and translucent when we cook them for puddings come from the roots of the cassava or manioc, a plant native to tropical South America. Most of the world's supply of tapioca comes from Java and British Malaya; but the cassava is now grown for local use throughout the tropics, where flour made from the roots is a staple food of the people.

The cassava is a semi-shrubby plant from five to nine feet high. Its thick fleshy roots, which may be three feet long and weigh 30 pounds, are filled with a milky juice. Two species, the sweet and the bitter cassava, are used for food, but the latter is the important species commercially. Its root contains a poison (prussic acid) under the skin, which must be thoroughly washed out before making the flour.

The plant is raised from cuttings from the stalks of the previous season, and enormous crops are produced with little or no attention. The roots, about 20 per cent starch, are pulped and washed through a sieve with a stream of water which carries with it the starch particles. After the starch has settled into a cake of wet flour in tanks, it is further washed and ground. To form tapioca, the cassava flour is moistened and dried on hot disks or plates. Pearl tapioca is formed by dropping the flour through perforated sheets before drying. The starch is also made into glue, gums, and other substances which are useful in industry. The milk, with the poison expelled by heating, is made into a tasty sauce called cassareep. The roots are ground into gaplek meal, a cattle food.

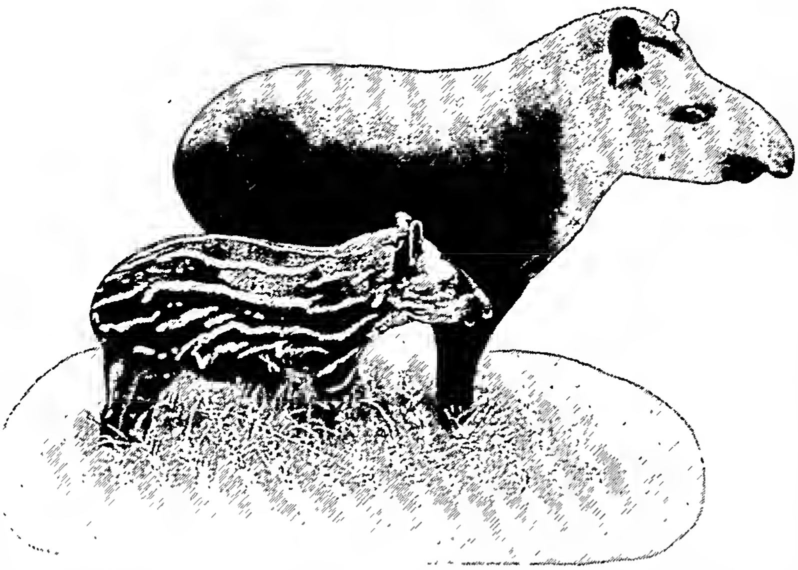
The cassava belongs to the family *Euphorbiaceae*, which includes the castor bean. Scientific name of bitter cassava, *Manihot utilissima;* of sweet cassava, *Manihot aipi.*

TAPIR (*tā'pẽr*). A clumsily built animal related to the rhinoceros and the horse, the tapir forms with them a special group of odd-toed ungulates, or hoofed animals; for all other hoofed animals have an even number of toes. The tapir has three toes on the hind feet and four toes on the fore feet, but only three toes of each fore foot are used. There are several species of tapir, all having thick skins and a nose and upper lip drawn out to form an elongated snout or short movable trunk.

Tapirs are found in India, the adjacent Malayan islands, and Central and South America. The Old World tapirs are larger than those of the New World, the common Indian form being eight feet long and 39 inches high at the shoulders. The legs and the fore part of the body are black, but the sides and back are white. Those of the New World are brown or blackish when adult. The common South American

form is about seven feet long, and inhabits thickly wooded districts. In the Andes it is replaced by a mountain variety living at altitudes of 7,000 and 8,000 feet. There are two species in Central America whose habits are little known. Tapirs commonly feed on young leaves, shoots, and fruits. Those of South America are destructive to plantations. They are hunted for their flesh and hides. Scientific name of Malay tapir, *Tapirus indicus;* common tapir of South America, *Tapirus terrestris.*

HOW YOUNG AND ADULT TAPIRS DIFFER IN MARKINGS



Here you see how a young South American tapir wears sporty stripes and spots in sharp contrast to the plain coat of his mother. By watching her at her meals, the young tapir will soon learn to use his long upper lip like an elephant's trunk in picking up tasty bits of food and conveying them to his mouth.

TAR. Wood, coal, bones, and other organic substances yield the heavy oily dark-colored liquid called tar when they are subjected to intense heat in retorts closed from the air. Commercially there are two chief kinds, wood tar and the coal tar which is the source of so many dyestuffs and other important products (*see* Coal-Tar Products).

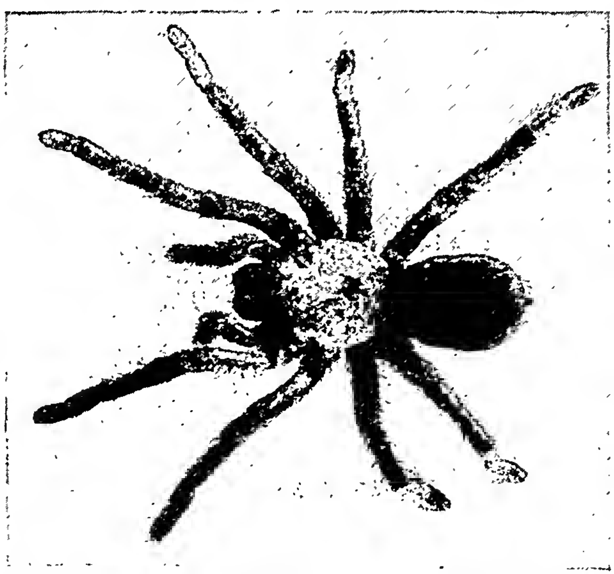
Much wood tar is produced in northern Europe, known as Archangel tar or Stockholm tar according to the source. In the United States, production is centered in the South. A cord of pine wood produces about 50 gallons. Because of its large creosote content wood tar is used to preserve wood and hemp rope. It is also used in medicine, notably cough syrups, and for antiseptic soaps.

Pitch, which has been used from the earliest times for waterproofing the seams of boats, is the black resinous substance obtained from wood tar or the non-resinous residue from coal tar after applying heat to drive out the volatile parts. Pitch is also obtained from petroleum, bone-tar, and stearine residues. The last two are valued by varnish and turpentine makers. Wood-tar pitch is much used to protect timber from insects and the weather; coal-tar pitch is used in the manufacture of black varnishes, for coating iron, and for making lamp black. Persia pitch is prepared from goat and sheep dung. Burgundy pitch, prepared from the exudations of the Norway spruce, is used for making medicinal plasters.

TARAN'TULA. This large fierce hairy running spider is much dreaded by natives of the warm countries where it is found. Its bite is fatal to insects and small animals and is popularly supposed to be dangerous to man. People once believed that the only cure for its bite was lively music which inspired the victim to dance until he fell exhausted and bathed in perspiration. From this belief came the name "tarantella," applied to an exceedingly lively Italian dance in which the speed increases to the end.

The true tarantula is found only in southern Europe, but the name is commonly applied to many other large spiders in various parts of the world. One of these, found in the south of the United States, is much larger and more venomous than the largest of the true tarantulas.

A KILLER THAT NEEDS NO WEB



Spiders as a class are not popular, but the tarantula is particularly disliked. It can spring so quickly, seizing its prey with those long, hairy legs, that it doesn't have to weave a web as so many spiders do.

These spiders live under rocks and logs, or in deep burrows lined with soft silk which they spin from little silk glands located in the abdomen. They do not spin webs in which to catch their prey, but wait for it like tigers, concealed among leaves or rubbish, or hiding within their burrows. When some unwary insect passes they rush out, bite it, and then drag it into their burrows. The bite either kills the victim at once, or paralyzes it and makes it helpless. The spider then feeds at its leisure. The tarantulas do not chew and swallow the substance of their prey, but suck out the blood and body juices. Many tarantulas are captured by large wasps, called tarantula hawks, and used as food for their young.

What TARIFFS MEAN *in the* LIFE *of* NATIONS

TARIFF. Suppose an American has gone for a trip to Brazil. As he approaches the United States again, an attendant on his ship or airplane hands him a slip of paper called a *declaration*. On it he must list all the articles he has bought in a foreign country and the price of each one. These articles brought from abroad are called *imports*.

When the traveler lands, a customs official examines his declaration and checks the contents of his luggage. He permits the tourist to bring in $500 worth of imports without charge. But he charges a tax, or *duty*, on goods in excess of that amount.

How much is the tax? To find out, the official consults a list showing all types of foreign goods on which duty must be paid and the rate on each. The list is called a *tariff*. The word comes from the Arabic *taʿrif* meaning "notification." This word also gave rise to the French word *tarif*, meaning "rate," and the Spanish *tarifa*, meaning "price list" or "rate book." Other meanings have arisen. In the United States "tariff" may mean a list of rates, the rate of duty on a certain article, or the law which sets the rates.

Collection of Duties

Tariff duties are levied by the government and go into the nation's treasury. In the United States, Congress passes the laws which set the rates. The Bureau of Customs, a branch of the Treasury Department, collects the duties. The Coast Guard assists in the enforcement of customs laws. The Bureau of Customs has offices, called *customshouses*, in every port and in some inland cities.

Travelers bring in only a small part of the foreign goods that enter the United States. Most of the imports are ordered by manufacturers and merchants and sent in by ship. A representative of the shipping company, or the owner of the goods, may pay the duty at the customshouse. As the goods are unloaded, the shipment is checked by customs inspectors.

Under another method, the goods may be sent to a bonded warehouse, and the duty paid when the goods are taken from the warehouse. Bonded warehouses are located in many important cities scattered over the country. This system permits payment of duties as the imported goods are sold. Handling of duty payments calls for specialized knowledge of tariffs and procedures. Therefore arrangements for paying duties and forwarding goods are usually made by *customshouse brokers*, who specialize in this work.

A duty may be a fixed percentage of the price of the article, called an *ad valorem* duty. If it is a fixed amount for the pound, gallon, yard, or other unit of weight or measure, it is called a *specific* duty. Ad valorem duties are usually levied on types of goods that have a wide range of values and qualities, such as textiles. Specific duties are better suited to standardized articles, such as sugar.

Free Ports or Foreign Trade Zones

Many nations have what are known as *free ports, free zones*, or *foreign trade zones* where goods intended to be reshipped to another country may be landed taxfree. In 1934 Congress permitted corporations to set up foreign trade zones in or near ports of entry. New York, New Orleans, San Francisco, Los Angeles, Seattle, and San Antonio have such zones. Goods may be stored or processed without payment of duty before re-export or entry into the United States. An amendment in 1950 permits manufacturing and exhibiting.

Changes in Tariff Methods

Tariffs have been levied since ancient times. In Greece and Rome both import and export duties were collected. In the Middle Ages cities and feudal lords levied tribute upon any trade passing through their territory. As nations with central governments replaced the feudal system, rulers took this right from the cities and the barons, and not only built customhouses on all their frontiers, but often charged a tariff on goods passing between provinces. In China, provincial duties, called *likin*, are still collected.

In the years immediately after the American Revolution, before the United States government was established, states levied tariff duties on goods imported from other states. New York, for example, levied a duty on New Jersey potatoes, and New Jersey in turn charged duties on certain New York manufactures. It is easy to see that trade would be hampered if every state had its own tariff duties. To prevent this, the Constitution provided that no state should place trade restrictions or tariffs on the products of any other state. This provision has been an important influence in developing the huge volume of domestic trade and the high standard of living in the United States.

Formation of Customs Unions

Neighboring nations or territories may unite to establish free trade among themselves. They set up an association called *customs union*. This union eliminates customs duties among member nations and adopts common customs policies toward nonmembers.

A Zollverein (customs union) of German states was organized in the 19th century and led to the foundation of the German nation (*see* Prussia). South African territories formed a customs union six years before the creation of the Union of South Africa in 1909. A modern customs union is the Benelux union, negotiated by Belgium, the Netherlands, and Luxemburg after the second World War.

Export Duties

In ancient times and in the Middle Ages export duties were more important than import duties. They were levied by European countries both for revenue and as a means of keeping grain and raw materials from leaving the country. By the middle of the 19th century, however, they had almost disappeared from Europe. Britain did away with them entirely in 1842.

In the United States they were prohibited by the Constitution, chiefly to satisfy the people of the South, who wanted no restrictions on their agricultural exports. In the past, export duties have been widely used in nonindustrial countries as a source of

revenue, but they are no longer considered sound economic practise. A few countries still levy them on certain products. Costa Rica and Guatemala, for example, have an export duty on bananas.

Free Trade and Protection

The two chief purposes of tariffs, on either exports or imports, have been these: first, to procure revenue for the government; second, to protect national industries. Tariffs levied for revenue only are usually kept low. Hence a country with this type of tariff is said to be a *free trade* country. No country, however, really has free trade; in other words, no country admits all imports duty free. Great Britain in the past was a "free trade" country; in fact, it was the only great nation with a tariff for revenue only. When it adopted a free trade policy in 1846, it was so far ahead of other countries in manufacturing that it did not need a protective tariff. After the first World War, however, rising tariffs in other countries caused the British also to set up a protective tariff on many imports.

Free traders believe in charging duties only on goods which cannot be produced at home. In special cases where a duty is charged on the importation of goods which are also produced at home, they would levy an internal revenue tax on the domestic supply equal to the duty on the foreign product. In this case, of course, the duty would not be protective.

Adam Smith, who has been called the "father of political economy," favored free trade. Most economists have held the same view. They hold that protection benefits chiefly the protected industries and that consumers pay dearly for it in having to pay a higher price for protected goods. They also point out that a protective tariff interferes with the normal economic process which develops industries in the regions best suited for them.

Arguments for a Protective Tariff

A protective tariff helps domestic industries by discouraging the importation of foreign goods. If the duty makes an imported article much more expensive than a like article produced at home, most people will buy the domestic product.

One of the chief arguments for a protective tariff is that it helps "infant industries" to grow. High tariffs built up many United States industries which could not have survived under foreign competition. The automobile industry, for example, in its early days demanded protection, and a fairly high tariff was levied on imported cars. The infant industry soon grew to giant proportions. American automobile factories became the most efficient in the world. Then the industry no longer needed high tariffs and wanted to see tariffs lowered all over the world so that it could sell more cars abroad

Another argument of American protectionists is that a high tariff is necessary to protect American workers from the competition of low-paid workers in other lands. They say that, because of the high wage level in the United States, the country must have a high tariff. Otherwise, cheap foreign goods will pour in, throw people out of work, and lower the living standard. As an example, they point to the importation of articles made by low-paid Oriental labor. This argument is perhaps the strongest one for an American protective tariff, now that the country is no longer in the "infant industry" stage.

Free traders admit that wages of workers in the Orient are low, and that Oriental countries can therefore produce some articles at a lower cost than it is possible to manufacture them in America. But they point out that the United States, on the other hand, supplies these countries with automobiles, typewriters, sewing machines, many types of machinery, and other items. The United States must either stop sending such goods to these countries or accept some manufactures from these countries to help pay for American goods the countries buy.

Again it is urged that protective tariffs are needed to prevent *dumping*. Large producers sometimes dump their goods—that is, sell them cheaper in foreign markets than at home, either to get rid of a surplus or to kill competition by foreign producers. Most countries have special provisions in their tariff laws to prevent such unfair competition. Another strong argument holds that protection helps a country build up essential industries and thus enables it to be more nearly self-sufficient in time of war.

Tariff Bargaining

In Europe the practise of tariff bargaining has existed for centuries. Nations have made treaties with other nations granting them tariff concessions—lower rates on certain products than the nation's established rates—in return for like favors. When a nation lowered its tariff duties to another nation, the lower duties automatically extended to all nations entitled to "most favored nation" treatment.

In the last quarter of the 19th century, nations began to include in their tariff laws two schedules of rates. The higher schedule was the regular rate and the lower schedule indicated the amount by which the rate might be reduced in tariff bargaining. Such provisions in tariffs are known as *reciprocity* measures. Sometimes nations inserted in their tariff laws penalty duties—higher than the maximum rates specified —which might be applied to imports from nations that did not make concessions.

The United States followed a nonbargaining policy, for the most part, until 1934. Then Congress, as a depression measure, gave the president power to make reciprocal trade agreements with other nations. He was permitted to reduce duties as much as 50 per cent below the rates fixed by the 1930 tariff.

The Tariff and Economic Nationalism

After the first World War there was a growing tendency for nations to try to make themselves economically independent—that is, to produce at home as much as possible of the goods they needed and to rely as little as possible on imports from other nations. Under this policy, the protective tariff became an important device for controlling a nation's whole economy. Tariff walls became higher and higher—in

many cases prohibiting entirely the importation of certain classes of goods. Bargaining became sharper, and a host of restrictive measures were set up to check imports. Among them were import quotas and licensing measures, barter agreements, control of foreign exchange, and even state monopolies on foreign trade (*see* Foreign Exchange; International Trade).

International Tariff Agreements

Following the second World War, world opinion swung toward the belief that economic recovery could be speeded by removing national barriers to foreign trade. The United Nations took steps to set up an International Trade Organization. A preparatory committee meeting in Geneva, Switzerland, in 1947 drafted an international trade and tariff agreement signed by representatives of 23 nations. It reduced national tariffs on thousands of products and provided that all negotiating countries should benefit from any concessions made by one country to another. Efforts to outlaw national import quotas and other quantitative restrictions were opposed by nations which are backward in industrial development. Their representatives pointed out that their struggling new industries could not survive without protection.

Protection and Free Trade in American Politics

The tariff has long been a hotly contested issue in American politics. Differences between the North and South on the nation's tariff policy were among the causes of the Civil War. In the 19th century, opinion on tariff policy was divided largely according to the economic interests of the various regions. The flourishing manufacturing districts of the northeast demanded high tariffs on European manufactured goods. The agricultural South and West favored low tariffs so manufactured products would be cheaper. They also hoped that reduction here would prompt similar action in European countries to which they exported cotton, tobacco, wheat, and meat products. In this era the Democratic party generally advocated low tariffs, while the Republicans stood for protection.

The issue has not been so clearly defined by regions in the 20th century. Much manufacturing that wants protection has moved to the South and West. Some agricultural industries, such as sugar-cane growing in Louisiana and sugar-beet growing in Colorado, want protection. On the other hand, many efficient manufacturing industries favor low tariffs the world over. Such tariffs enable them to compete favorably in foreign markets with less efficiently made goods.

Changed Emphasis in Tariffs

For many years tariff duties furnished a considerable part of the federal revenue—90 per cent before the Civil War and nearly 50 per cent as late as 1913. With new sources of revenue, such as the income tax, import duties have become of minor importance to the national budget. They now furnish less than 10 per cent of the revenue. In fixing rates, therefore, the chief consideration is their effect on economic life rather than their effect on the national budget.

When a tariff bill comes up in Congress, special interests lobby for favors. To obtain rates demanded by industries in their own states, congressmen have resorted to "log-rolling"; that is, they would support each other's demands for high tariffs on certain products. This resulted in raising rates generally.

These evils created demand for a permanent, unbiased body to "take the tariff out of politics." In response, the government created the United States Tariff Commission in 1916. But it was limited to gathering information for Congress and the president. It has no power to fix rates.

History of the Tariff in the United States

The policy of the United States has been in favor of protection most of the time since the first tariff act was passed in 1789. Alexander Hamilton first successfully urged a protective tariff to protect infant industries. Although the 1789 tariff was not high, the preamble to the act stated that one of its objects was to encourage and protect manufacturers.

Henry Clay urged protection of manufacturers as a means of building up a better home market for agricultural products, and a temporary protective tariff was levied in 1816. In the following year, President Monroe asked for a strong protective tariff. After several bills were defeated Congress passed a bill in 1824 intended to exclude foreign goods which competed with American manufactures.

The famous Tariff of Abominations (1828) was the next protectionist measure. It fixed prohibitive duties on cotton and woolen goods and other products. Southerners, fearing that the high tariff on British cotton imports would lead to retaliatory measures against their products, protested vigorously. They even threatened to secede. Their opposition led to the Tariff of 1832, which in general restored protective measures to the 1824 status and removed some of the more striking features to which the South objected (*see* States' Rights).

Eventually the so-called Compromise Tariff of 1833, sponsored by Henry Clay, was passed (*see* Calhoun). It provided for a gradual reduction of the tariff until 1842, after which all imports were to be taxed 20 per cent. But in that year another high tariff bill was passed, because the depression of 1837-42 had caused a serious decrease in revenue from the customs, and government receipts were insufficient to meet expenses.

By 1846 prosperous times had returned, and the Democrats were in power. They passed the Walker Tariff, which abandoned the protective policy. Low tariffs prevailed until the Civil War. Then, in 1861, the Republicans passed the Morrill Tariff, a distinctly protective measure. Except for some reduction in 1872-74, tariff rates thereafter steadily increased until the Democratic Wilson-Gorman Tariff in 1894. The McKinley Tariff of 1890, meanwhile, had reduced duties on a few commodities and materially increased them on others.

In the Dingley Tariff of 1897 and the Payne-Aldrich Tariff of 1909 the Republicans restored rates to about the same level as they were in the McKinley Tariff. Duties on many articles were lowered and the

free list was greatly increased by the Underwood-Simmons Tariff of 1913, a Democratic measure. Rates were again raised by the 1921 Emergency Tariff and by the Fordney-McCumber Tariff of 1922. They went still higher with the Hawley-Smoot Tariff of 1930.

When international trade fell off alarmingly during the economic depression, the Democratic Congress passed the Reciprocal Trade Agreements Act of 1934. This act delegated some of Congress' tariff-making powers to the president. It permitted the State Department, acting for the president, to reduce rates by as much as 50 per cent for nations granting similar concessions to the United States. When the act was renewed in 1945 the president was authorized to cut existing rates by an additional 50 per cent. Agreements were made with Canada, Great Britain, most Latin American nations, and many other countries.

Seek Wider Tariff Agreements

The United Nations tried to ease tariffs throughout the world as a step toward economic development. In 1947–48 one of its agencies, the International Trade Organization (ITO), drew up an agreement to this end, but several nations failed to sign it. In 1951 the United States joined in another effort to soften tariffs, but Britain refused to give up duty preferences.

TARKINGTON, NEWTON BOOTH (1869–1946). In such novels as 'Seventeen' and 'Gentle Julia', Booth Tarkington pictured the life of the average Midwestern family in the "horse and buggy days" of the early 20th century. Tarkington well knew that leisurely, friendly life. He was born into a well-to-do Indianapolis family on July 29, 1869. Indianapolis was then a quiet town, untouched by industrial growth.

As a boy Tarkington was frail and nervous. But he enjoyed many of the pranks that he later told about in 'Penrod' and 'Penrod and Sam'. He spent hours "dictating" Wild West stories to his older sister. He attended Phillips Exeter Academy and Purdue University. In his junior year he transferred to Princeton. There he sang in the glee club and helped found the Triangle Club. He wrote and acted in several school plays. Failure to finish his studies in Greek kept him from graduating.

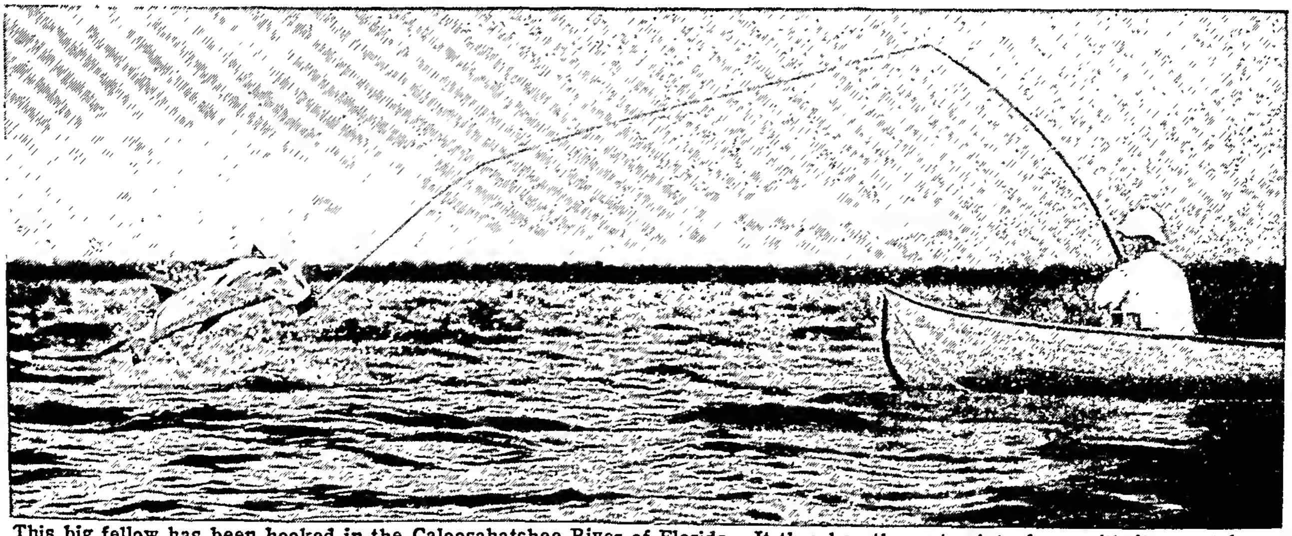
After college Tarkington returned to Indianapolis. He wanted to be an artist, but sold only one of 32 drawings. He turned to writing. In his first five years he earned only $22.50. But in 1899 *McClure's Magazine* accepted 'Monsieur Beaucaire' as a serial. That same year 'The Gentleman from Indiana' was published. It was an immediate success. For the rest of his life Tarkington wrote at least one novel or play yearly. He also wrote short stories for popular magazines. Most of his work was intended for pure entertainment. But occasionally he wrote with such deep understanding that his books were revealing studies of human nature. Two of these serious novels were 'The Magnificent Ambersons' and 'Alice Adams'. These won Pulitzer prizes in 1919 and 1922.

In 1902 Tarkington served in the Indiana legislature. That same year he married Laurel Fletcher. Their only child, a daughter, died in young girlhood. In 1911, Tarkington married Susannah Robinson. He maintained homes in Indianapolis and Kennebunkport, Me., filled with pictures and rare books. He called his Kennebunkport house "The House that Penrod Built." He traveled widely, and most of his plays were written in Europe with his friend and collaborator, Harry Leon Wilson. Late in life Tarkington became partially blind. He could not read or write, but he dictated many stories to his secretary.

TARPON. When a fisherman hooks this American game fish, it leaps into the air with furious twists of its great body. A tremendous fight follows, and the fish often wins. This species offers such sensational sport that it is one of the most prized of all catches.

The tarpon is a member of the herring family. It attains a length of eight feet, and may weigh up to 250 pounds. Its armor of round, silvery scales, two to three inches in diameter, has earned it the name of "silver king." The flesh is little used for food.

TARPON FISHING IS AN EXCITING SPORT



This big fellow has been hooked in the Caloosahatchee River of Florida. It thrashes the water into foam with its great leaps which may reach 7 to 8 feet above the water and cover an arc of 30 feet. It takes skillful handling to land a powerful fighting fish.

The scales are sold as souvenirs. The tarpon is found on the Atlantic coast from Long Island to Brazil. It is abundant off the coast of Florida. There the best season for tarpon fishing is from April to November. The tarpon breeds in the West Indies and spawns in the open sea but close to the coasts. The eggs hatch into semitransparent, ribbonlike larvae, about an inch long. Winds and currents sweep the larvae inshore, and as young fry they live in inland lagoons. When they reach maturity, they return to the sea, but may travel up rivers in search of food. Scientific name, *Tarpon atlanticus*.

TARSIER. One of the oddest of animals is the spectral tarsier. Enormous yellow-brown eyes occupy the entire front of the head and almost meet over the tiny, flat nose, giving it a ghostlike appearance. It lives in the jungles of the Malay archipelago. Few people see it, for it is active only after dark. Its strange, unearthly cries in the night—it sounds like a man strangling—terrify the natives. They shun it in superstitious fear.

A FIGHTING TARPON

Here are close-ups of a tarpon fighting for its life. It holds its body in a curve while out of the water and falls on the concave side. The grotesque head with gaping jaws is a terrifying sight. Notice the whiplike filament on the dorsal fin.

The tarsier is somewhat smaller than a squirrel. It has grayish brown fur, a long ratlike tail with a tuft of fur at the end, and large bare ears resembling a bat's. The huge eyes help it to see at night. The eyeballs do not move as human eyes do, but the head can turn in an arc of 160 to 170 degrees. Just when it appears that the little animal is going to wring its own neck, the head snaps around to the other side.

THE SPECTRAL TARSIER

This little tarsier from the Philippines clings to its zoo cage, anxiously watching the spectators with its strange eyes.

The long bony fingers and toes end in disclike suction pads which help them to grasp branches. Some of them have tiny claws. Others have flattened nails. The tarsal, or ankle, bones of the rear legs are greatly elongated. From this fact the animal gets the name of tarsier. These long bones enable it to make great leaps in proportion to its small size. It stands on tiptoe, the arms held straight forward, or slightly bent at the elbow, and makes a "standing broad jump" of three or four feet.

Tarsiers feed by night, leaping through the trees or across the jungle floor in search of lizards, small snakes, insects, or fruit. By day they sleep in the trees, clutching a branch with the almost human hands and feet.

One of the Primates

This strange little animal is one of man's closest relations. It is a mammal, belonging to the order of Primates, which includes also man, the apes, the monkeys, and the lemurs. Scientists believe that it is closer to the common ancestor of man than any of the other Primates. Little is known of its breeding habits, but it is believed to bear only a single young at a time.

There are several species, comprising the suborder *Tarsioides*. Scientific name of the spectral tarsier, *Tarsius spectrum*.

TARTARIC ACID. Fermenting grape juice leaves in a cask a hard crust of impure acid potassium tartrate, called argol. Argol, partially purified by dissolving and recrystallizing, is called "tartar"; a final purification that eliminates coloring matter yields "cream of tartar." Some baking powders are mixtures of soda (sodium bicarbonate) and cream of tartar. The two compounds interact when moistened and give off carbon dioxide, which lightens dough.

When boiled with a suitable form of calcium, then treated with sulphuric acid, cream of tartar yields tartaric acid ($C_4H_6O_6$). This is used in medicine, in

HIGH IN THE MOUNTAINS OF "BACK OF THE BEYOND"

This team of ten oxen patiently awaits its load on one of the excellent mountain roads of Tasmania. The mountain forests of beech, pine, and eucalyptus supply the island's large timber industry. These strong shaggy trees are "blue gum," or eucalyptus.

photography, and in dyeing. It forms various tartrates, or salts. Rochelle salt is sodium potassium tartrate; tartar emetic is antimony potassium tartrate.

Certain puzzling features about tartaric acid led Louis Pasteur, in 1848, to one of his most famous discoveries. Chemists had found that solutions of tartaric acid rotated polarized light to the right, or were *dextrorotatory* (*see* Light). A seemingly identical substance, racemic acid, produced no effect on polarized light. Pasteur found that two kinds of crystals can be obtained from racemic acid. One kind is dextrorotatory and is the familiar form of tartaric acid. The other kind of crystal rotates polarized light to the left (*laevorotatory*); it is chemically identical with the familiar form, but its crystals are mirror images of the dextrorotatory ones. In racemic acid, the two kinds of crystals neutralize each other in effect. This discovery founded the science of *stereochemistry*, which studies the effects of a substance's structure on its physical and chemical properties. Many substances have since been found to exist, like tartaric acid, in two or more forms which seem chemically identical but differ in the way their atoms are arranged in space. Sugars are good examples (*see* Sugar).

TASMANIA, AUSTRALIA. The smallest state of the Commonwealth of Australia is the heart-shaped island of Tasmania. Once a part of the mountain ridge of eastern Australia, it thrusts up between the Indian Ocean and the Pacific, about 140 miles off the southeast tip of the mainland, across Bass Strait. In the slow days of sailing ships, Tasmania seemed so remote that people called it "the back of the beyond." But now steamship and air lines link it to Australia.

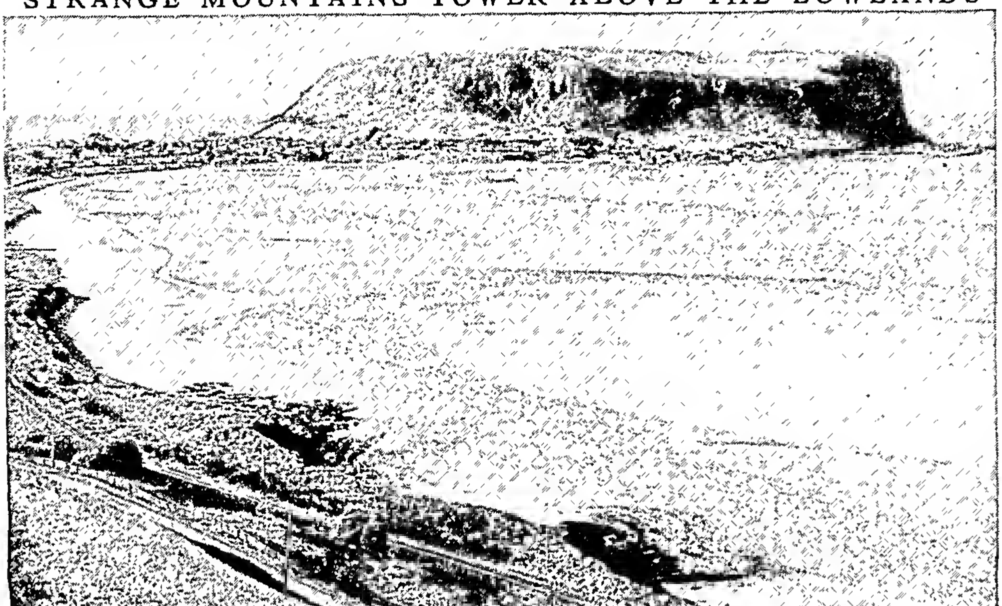
Beautifully green and rugged, the island is a favorite vacation spot for the "mainlanders." It is about 180 miles long and 175 miles wide. Including several small near-by islands, the state has a total area of 26,215 square miles, about that of West Virginia. From a narrow fringe of coastal plain, Tas-

THE STRANGE "WOLVES" OF TASMANIA

This is a Tasmanian female wolf with its cubs. It bears one to four at a time. A marsupial, it carries them in its pouch for three months after their birth, then hides them in a den until they can follow the mother. They learn to hunt by night and sleep by day. Their blackish-brown markings explain why these strange animals are also called Tasmanian tigers or zebra wolves.

mania towers up to a central plateau about 3,500 feet high. The highest peak, Ben Lomond in the northeast, rises to 5,160 feet. Masses of thickly forested mountains cover the west and south, where very few people live. Here grow the giant beech and pine and the enormous "blue gum" eucalyptus—one of the strongest and most valuable woods in the world—which give Tasmania its lumber and paper industries. Rain-bearing westerly winds give Tasmania a cool, moist climate like that of Ireland. Few of the many lakes and rivers are navigable. But engineers have harnessed part of the abundant water power by damming the Great Lake, near the heart of the island.

STRANGE MOUNTAINS TOWER ABOVE THE LOWLANDS



This picture of Table Cape, overlooking the town of Wynyard on the north coast, shows a typical bit of Tasmanian landscape. The island is an ancient plateau which has been carved by erosion into irregular ranges and great flat-topped mountains with steep sides. The coasts are bold and deeply indented.

Most Tasmanian animals and plants are like those of Australia (*see* Australia). But the island has two beasts of prey found nowhere else. One, the Tasmanian zebra wolf, resembles the common wolf, but it is striped and carries its young in a pouch. The other, the Tasmanian devil, is smaller but even more fierce. Both prey on sheep.

Tasmania has many small farming and industrial centers. Rail and air lines link the chief cities—Hobart, the capital (population, 1947 census, 76,567), in the south and Launceston (40,449) in the north.

The fertile farmlands of the north grow chiefly oats, potatoes, and beans. The south produces quantities of apples and pears and exports fresh and dried fruits, jams, and preserves. Sheep and cattle are raised and wool is an important export. The uplands are rich in minerals, and mining and metal-working are major industries. Tasmania is Australia's main source of copper, zinc, and limestone. It also produces tin, lead, coal, silver, and gold. Hardwood lumber is exported; and the poorer timbers and hardwood wastes are used to make paper pulp.

The Dutch explorer Abel Tasman discovered the island in 1642, naming it Van Diemen's Land. The natives were a woolly-haired race, darker than the "blackfellows" of Australia and even more primitive. No settlers braved the rugged island till 1803, when England sent the first of thousands of convicts. These and the later settlers clashed often with the natives, and exterminated them. Convict immigration was ended in 1853, when the island was named Tasmania and given representative government. But discovery of gold in Australia in 1851 had lured away so many of the young people that the island's development lagged for nearly 20 years. In 1901 Tasmania became one of the states in the Australian Commonwealth, formed that same year. Population (1947 census), 257,078.

TAS'SO, TORQUATO (1544–1595). The story of this great Italian poet reads like a romantic tragedy. He was born at Sorrento in that period of Italian history when the wealth and power of the country was in the hands of many princes or dukes, whose courts were centers not only of luxury but of art and learning. It was the custom at that time for poets, artists, and scholars to attach themselves to the courts of these dukes. Thus their livelihood was assured, but, on the other hand, they were not free to follow their own inclinations and were affected by any change in their patrons' fortune or favor. The father of Torquato Tasso was himself a poet and had suffered so many ups and downs in his career as a courtier that he decided his son should follow a more certain profession. Accordingly he sent the lad to the University of Padua to study law, but Torquato gave more attention to philosophy and poetry. Before he was 18 he had written 'Rinaldo', a romantic poem dealing with the stories of Charlemagne, which showed such originality that his father was forced to allow him to follow his bent and devote himself almost exclusively to the art of poetry. He went to Bologna in 1563.

After a short period of study at the University of Bologna, Tasso enjoyed five happy years under the patronage of Cardinal Luigi d'Este at Ferrara, where he became a favorite of the most brilliant court in Italy. Later he entered the service of Alfonso, duke

of Ferrara, and in his 31st year finished his masterpiece, 'Jerusalem Delivered', a religious epic based on the First Crusade. Instead of publishing it at once, he sent it to a group of scholars and churchmen at Rome for their opinion. They criticized the poem so severely that the sensitive Tasso was driven almost to madness. The jealous courtiers added to his sufferings by slanders and insults, and the poet became the prey of melancholy and irritability that amounted almost if not quite to insanity. One evening in the presence of the Duchess he drew his sword to stab a servant who, he fancied, was spying on him. Gossip said that this state of mind was aggravated by his love for the Princess Leonora, sister of the Duke, to whom he addressed many impassioned lyrics. At last Tasso displayed such violence of temper that the Duke sent him to a madhouse, where he was kept in confinement for seven years. During this time he wrote some of his best short poems and a series of philosophical reflections. Alfonso was finally induced to release him in 1586.

After several more unhappy years, fortune at last seemed to smile on the broken old man. He was invited to Rome to receive at the hands of the pope the poetic crown of laurel—but the honor came too late. Before the ceremony was performed Tasso fell ill and died in the Convent of St. Onofrio.

His chief works are 'Rinaldo' (1562); 'Aminta' (1573); 'Jerusalem Delivered' (1574); 'Torrismondo' (1586).

TASTE. The sense of taste depends on little projections called "taste buds" located on the tip, sides, and back of the tongue (*see* Tongue). The taste buds contain a special nerve ending from which nerve fibers extend back to the brain.

When any solution or substance capable of dissolving in the saliva is taken into the mouth and comes in contact with the nerve endings, a nerve impulse is started. Then we say we taste the substance. An insoluble substance has no taste, but may be felt through touch.

We have four kinds of true taste—sweet, bitter, salty, and sour, each with its own nerve endings and fibers. Flavors are fused sensations of taste, smell, and touch, in which odor plays the most prominent part. (*See also* Smell.) The flavor of vanilla ice cream is made up partly of odor from the vanilla, partly of taste through stimulation of the sweet taste buds, partly of cold through stimulation of the cold spots, and partly of smoothness through stimulation of touch (*see* Touch).

TATARS. "Well may they be called Tartars, for their deeds are those of fiends from Tartarus!" Such, it is said, was the appalled exclamation of the pious king, St. Louis of France, on hearing of the havoc wrought by the Mongol hordes that seethed up out of Asia in the 13th century; and such, it may be supposed, was the association of ideas that made "Tartars" out of "Ta-ta Mongols." The name of this tribe came to be applied to the hordes of Genghis Khan and other Mongol invaders of later times (*see* Mongols), as well as to the kindred peoples they subdued; and the region from which they came, now loosely known as Turkestan, with the neighboring regions they overran, was called Tartary.

The name Tatar today is usually reserved for a group of tribes in Russia and Siberia, numbering about 3,000,000, mostly of Turkish origin and of the Mohammedan religion. Those in Russia are remnants of the Mongol invasion of the 13th century, though they have very slight traces of Mongolian blood or none at all.

TATTOOING. Tattooing, that queer sort of skin decoration found among many half-civilized peoples, is usually done by pricking in designs with an awl or needle dipped in different colors. Some patterns are sewed in by drawing under the skin a thread which has been dipped in color. Others are made on certain dark-skinned races by a process called cicatrization or scar-tattooing. This is done by repeatedly cutting the skin in the same place so that when it heals a raised scar is left. Many African tribes mark their boys in this fashion, rubbing wood ashes into these great gashes on the face or body, which causes swelling and healing with a purple color. In some tribes no girl is eligible for marriage until she has been elaborately tattooed. Sometimes tattooing is done as a mark of courage shown in war or to present a more terrifying aspect before the enemy. Sometimes it has a religious meaning, and again it is a sign of mourning. Among sailors of all nations, tattooing is still popular. Their arms and chests often display designs even more elaborate than those of savages.

TO PLEASE HIS FRIENDS AND FOOL HIS ENEMIES

This Maori warrior of New Zealand lies back while the tattooer works. This kind of tattooing (now rare) was designed not only to beautify the wearer, but also to conceal from his enemies any expression of fear.

PAYING *the* EXPENSES *of* GOVERNMENT

TAXATION. Every government requires money with which to operate. Most of this money comes from taxes, which are compulsory contributions to the government. In the United States, taxes are collected by the federal government, all the state governments and the District of Columbia, and thousands of local governments, including counties, cities, towns and villages, and school districts.

In some ways, taxes are similar to the prices charged for goods and services by stores, restaurants, hotels, and other forms of private enterprise. Prices are charged to meet the costs of producing goods and services provided by private firms; taxes are imposed to meet the costs of services (and occasionally goods) provided by governments.

How Prices and Taxes Differ

There are, however, two great differences between prices and taxes. First, the prices paid by a person or firm are directly related to the amount of goods or services purchased. The fact that a buyer is willing to pay a certain price indicates that he thinks the product is worth at least that amount. In taxation, however, there is usually only an indirect relationship between the cost to the taxpayer and the benefit he receives from the government. In many instances, persons who bear the burden of a particular tax may not be aware of the benefits paid for by the tax or even of the tax itself. This is seldom the case with prices.

Some taxes are imposed to meet the costs of government services specifically benefiting the taxpayer. For example, the proceeds of gasoline taxes are often reserved for building and maintaining highways. The higher the tax, the more money that is available for highway construction. This association between taxes and highway benefits, however, is still more indirect than with most things sold for prices.

The second basic difference is that taxes are compulsory whereas prices are not. Property owners *must* pay property taxes, and those with a net income over a certain amount *must* pay income taxes. People can avoid paying prices by doing without goods and services that they decide are not worth the cost. For most people, however, taxes can be avoided only in part. For example, some sales taxes can be avoided by not buying the taxed articles; and income taxes can be reduced by keeping income below a certain level in a given year.

In the market system, a person who decides that the price of an article would exceed its value to him is free not to make the purchase. Individual taxpayers, however, usually have little choice as to the amount and quality of the benefits paid for with their tax money. These matters, as well as the amount of the taxes, are determined by the majority of voters in a community or by their elected representatives. Those who disagree with the community's decision have to go along with the majority. For example, persons who think better roads are not worth additional taxes on gasoline have to pay the taxes and accept the benefits favored by the majority.

Who Should Provide the Benefits?

Sometimes there is a question as to whether services should be provided by private enterprise through the market system and financed by prices or should be provided by the government and financed by taxes. In such cases democratic communities usually prefer the market and price system if it can do the job efficiently.

Why then do not governments turn the job of providing goods and services over to private enterprise? Or, why do not governments sell goods and services for a price instead of imposing taxes to pay for them?

First of all, the benefits of many services cannot be apportioned among individual citizens. Such services include police and fire protection, the administration of justice, national defense, and flood control. These things cannot be divided and sold to persons who decide just how much they want to buy of police protection or national defense.

Secondly, some services which benefit individuals directly also benefit the entire community as well. Thus public education might be financed by the payment of tuition fees (as in private schools); but if it were, many persons would get less education, and the productivity, morality, and culture of the entire community would suffer. More specifically, high-school or college education benefits the persons who receive the schooling no less than the business firms who employ such graduates.

Thirdly, many services and goods provided by modern governments are for the benefit of the needy who cannot assist themselves. For example, the federal, state, and local governments assist many dependent or handicapped persons who cannot provide for themselves. Such people include dependent children, the aged, the blind, disabled veterans, and indigent sick.

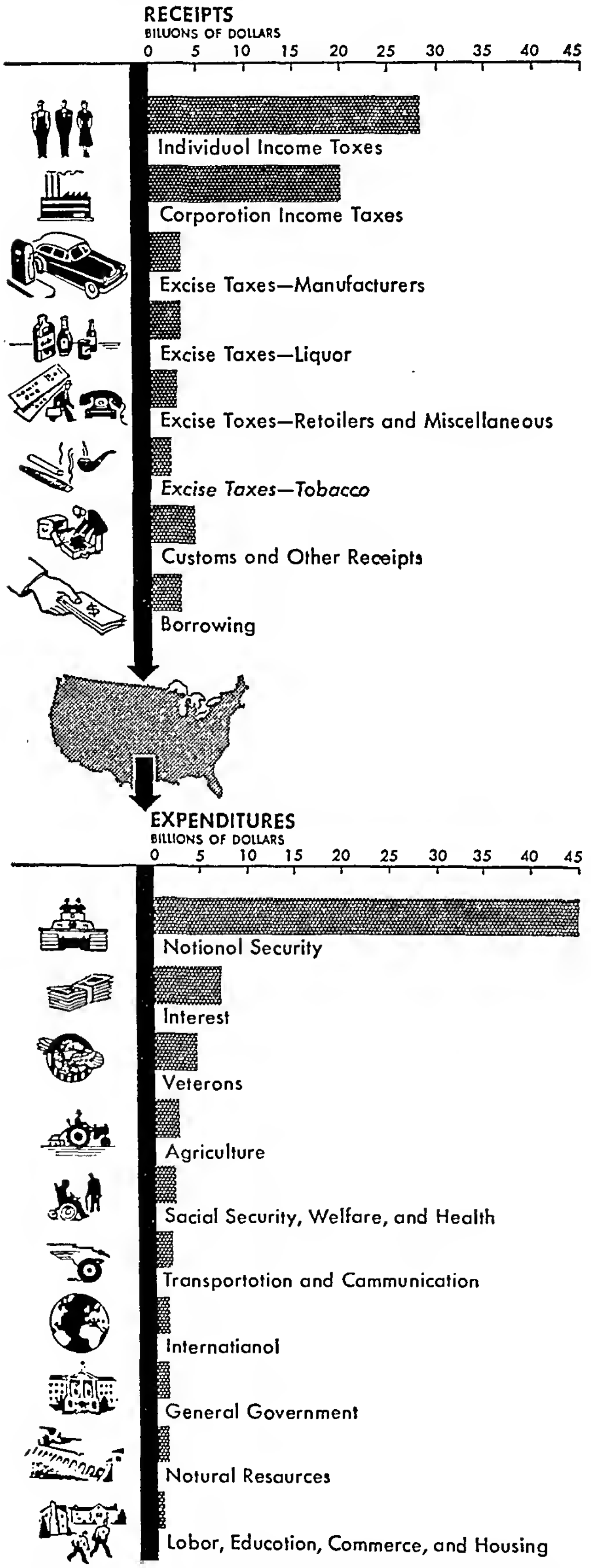
Purposes of Taxes

Governments do not always depend upon taxes alone for operating funds. All governments may borrow money, and sovereign governments may meet their expenses by creating money.

In the United States, the borrowing power of state and local governments is limited by state constitutions. It is also restricted by the fact that banks and other lending institutions hesitate to lend more than is practicable. On the other hand, the power of the federal government to borrow money is limited only by self-restraint. This is partly because its control over the banking system is such that it can always borrow from banks if no one else will lend to it. In addition, the federal government has exclusive power over the nation's money and can create *currency* (coins and paper money). Borrowing from banks has the same effect as creating currency because the borrower's checking accounts are increased by bank loans and no other accounts are decreased.

Could not then the federal government pay its expenses simply by printing more money or borrowing

The Federal Budget



This is a typical budget for one year during the 1950's. Tax receipts had to be augmented by borrowing to meet expenses.

from banks? The answer is that when governments do this, inflation occurs. Prices rise and money loses its value because there is too much of it. The United States has experienced inflation during and after each of its major wars simply because the government did not impose enough taxes to pay for the wars as they were being fought. Inflation was worse during the Revolutionary War when continental notes were printed literally by the wagon load. The expression "not worth a continental" is used to this day.

This condition leads to a highly important aspect of taxation. From the viewpoint of most individual governments, the purpose of taxation is to get money to pay the costs of running the government. From the viewpoint of the whole country, however, the purpose of taxes is to take money from individuals and business firms instead of borrowing from banks or creating money, and thus avoiding inflation.

Taxes also serve other purposes. One of these is to control or eliminate undesirable activities. For example, the sale of narcotics is controlled through very high taxes; the importation of many foreign goods is restricted by "protective" tariffs; and the issuance of bank notes (paper money) by state banks has been eliminated by a high tax on such notes.

Kinds of Taxes

There are three main kinds of taxes—taxes on property or wealth, taxes on income, and taxes on sales. Each of these taxes contains three important elements: (1) a determination of the value or amount of the subject to be taxed, called the *tax base*; (2) fixing the *tax rate*, which is the percentage of the base to be collected; and (3) the actual *collection*.

The *property tax* is the main revenue source of cities, towns and villages, school districts, and other local government units in the United States. It is still used by some state governments. A property tax has been imposed by the federal government on only three occasions and at no time since the Civil War.

Property taxes always apply to real estate—land and buildings. They may also apply to movable personal property such as machines, business inventories, household furnishings, clothing, and jewelry. The valuation of property for tax purposes is done by specially trained tax assessors.

Another form of taxes on wealth are the estate and inheritance taxes. These are imposed at the time of the owner's death upon the transfer of his property to his heirs.

Income taxes are levied on the annual incomes of persons and corporations. They are the main source of revenue for the federal government and are used by about half the state governments and by some local governments. The greatest problems of income taxation arise in defining taxable income. In most cases, taxpayers are allowed to deduct their business and professional expenses from the gross (total) income. Individuals are also allowed deductions for dependent persons whom they support (exemptions), for contributions to charity, and for various other items. That which remains is taxable income.

Much of the federal tax on individual incomes is collected on a "pay as you go" basis through *withholding*. Under this system, the employer withholds a portion of each employee's wages and turns this over to the government as current payments against each employee's annual income tax. Also withheld are social security taxes (*see* Social Security).

In addition to taxes on annual income, corporations may pay taxes on excess profits, undistributed profits, and capital gains. Businesses may be subject to other taxes such as licenses to operate and payroll taxes for social security benefits.

Sales taxes are levied on the amounts of sales. There are several kinds of sales taxes. Excise taxes apply to particular sales, such as tobacco, liquor, movie admissions, or gasoline. General sales taxes apply to a wide range of commodities. Single-stage general sales taxes may be collected from manufacturers, from wholesalers, or from retailers. Multistage, or turnover, sales taxes are collected on all sales. About half the states and some cities use general retail sales taxes. These are collected by retailers from customers and then turned over to the taxing governments.

Since states may not tax interstate commerce, they cannot tax transactions of their citizens with out-of-state firms. Some states, however, collect *use* taxes on articles bought from out-of-state firms but consumed, or "used," within the state.

Still another form of tax is the *poll* tax, levied on persons. The name comes from the Anglo-Saxon word *poll*, meaning "head." Always unpopular, poll taxes have now been abolished in all but a few states where the payment of such a tax is often a qualification for voting.

Three Characteristics of a Good Tax

1. *A good tax should be equitable, or fair.* In general, taxpayers will accept a tax that is just, especially if the tax money is used for a worthy purpose. Taxes considered to be unfair have sparked some of the bitterest conflicts in history, including the American Revolution and the French Revolution.

In modern democratic communities, the fairness of a tax is usually associated with two principles. The first is the benefit principle, by which taxes are imposed according to the benefits received. One example of such a principle at work is the tax on gasoline. Another example is the tax on property, which pays for police and fire protection, streets, and other services benefiting property.

The second principle governing a fair tax is that of ability to pay. This dictates that wealthy persons should pay more in taxes than the poor. It also presumes that persons with higher incomes should pay a larger percentage of their income in taxes than persons with lower incomes. When the percentage, or rate, increases with the amount of income (or wealth), the tax is called *progressive*. In the United States the chief progressive taxes are the personal income and the estate and inheritance taxes. Excise taxes on luxuries are also generally thought to be levied in accordance with ability to pay, on the basis that only families with higher incomes buy luxuries.

Not all taxes levied in the United States are progressive. Retail sales taxes take a higher proportion of income from low-income families than high-income families. These taxes are called *regressive*. Even sales taxes, however, recognize in part the ability to pay principle if they exempt basic necessities such as food and rent.

The principle of fairness also dictates that one person shall not pay a higher tax than another person in similar circumstances. This condition is often difficult to achieve because different kinds of income require different kinds of tax treatment. For example, special provisions must be made for the author who spends three years writing a book and then sells it for a lump sum. Under a straight progressive income tax, the author would pay a larger total tax than the person who received the same amount of income spread equally over three years' time.

In many cases the economic and political development of a country is reflected by the progressiveness of its tax structure. Modern industrial nations, such as Great Britain and the United States, rely chiefly on progressive income and inheritance taxes. Economically backward countries often rely heavily on sales and turnover taxes.

2. *A good tax should have no unintended harmful effects.* Probably no tax completely achieves this objective. Some taxes, however, are more harmful than others. For example, England once imposed a tax on windows. The people then built houses with fewer windows or with no windows at all. The unintended effect was to restrict light and ventilation.

Some modern examples of unintended harmful effects to be guarded against are as follows:

a. Restriction of socially desirable consumption, such as the consumption of milk or medicine or the circulation of books and newspapers.

b. Restriction of investment at times when investment is needed both to furnish employment and to increase the nation's productivity. Excessive business income taxes may deter firms from undertaking risky ventures, particularly because the government demands a share of any profits but ordinarily does not offer to share any losses. An excessive property tax on machinery may discourage the introduction of labor-saving machinery. Property taxes on real estate in a few cities have risen to the point where they have virtually blocked new construction.

c. Restriction of productive effort. Income taxes on additional earnings may be so high as to make workers avoid additional work. For example, in England during World War II income tax rates were so high that workers could keep only relatively small fractions of additional earnings. The high rates reportedly caused many workers to refuse overtime work and led to considerable absenteeism.

d. Restriction of incentives to avoid waste. Very high taxes on business profits may cause firms to relax their guard against waste and to make expenditures

which they would not ordinarily make. The reason is that additional profits resulting from more efficient operation would be largely taken by the government.

e. Lowering taxpayer morale. If a tax is considered to be unfair or if rates are excessively high, taxpayers will resent it and try to evade it. This may create disrespect for other taxes and for law and order in general.

3. A good tax should be cheap and easy to collect. The more expensive a tax is to collect, the less revenue the government has to spend on goods and services. In addition, a tax which is difficult to collect is usually not well enforced. Honest taxpayers pay it, but less honest ones do not. This penalizes honesty and lowers taxpayer morale. An example of a tax which has been almost impossible to administer successfully is the property tax on personal possessions, such as clothes and jewelry, and intangible goods, such as stocks, bonds, and bank deposits. Tax assessors hesitate to invade homes to search for and appraise the value of household goods. Then too, clothes, jewelry, and securities can be easily hidden. As a result, the property tax on such possessions has broken down almost completely, and some states have given up the attempt to tax personal property of any kind.

The rates of most taxes can be raised to the point where they become difficult to collect because there is so much incentive to evade them. Therefore individual taxes fulfill the requirement of easy collection only as long as their rates are moderate. Probably this fact, as much as anything else, accounts for the wide variety of taxes found in the United States and elsewhere.

The Long History of Taxation

One of the early ancestors of modern taxes was the system of payments to rulers in medieval times. The residents of a manor were obligated to pay the lord of the manor a share of their crops, a certain number of days of labor, and military services in time of war. In turn the manorial lords furnished goods and services to the king or other ruler of the realm. As the use of money became more widespread, currency replaced payments in crops and physical labor.

Taxes have played an important part in the development of modern democratic governments. In the Magna Carta (Great Charter) of 1215, the nobles of England forced King John to forego all payments to the throne unless they were accepted "by the common counsel of our kingdom, except for ransoming our person, for making our eldest son a knight, and for once marrying our eldest daughter." Out of this provision that taxes be approved by a "common counsel" grew the British practice of putting control over taxes exclusively in the House of Commons. This development has its counterpart in the United States Constitution, which provides, in Article I, Section 7, that "All bills for raising Revenue shall originate in the House of Representatives."

Until 1909 the largest part of the income of the United States government was derived from customs, or tariff duties imposed on goods imported into the country (*see* Tariff). Now, however, such customs collections make up less than 6 per cent of the federal revenue. The biggest source of income today is derived from income taxes on individuals and corporations. This kind of tax was authorized by the 16th Amendment to the Constitution, adopted in 1913. (*See also* United States Constitution.)

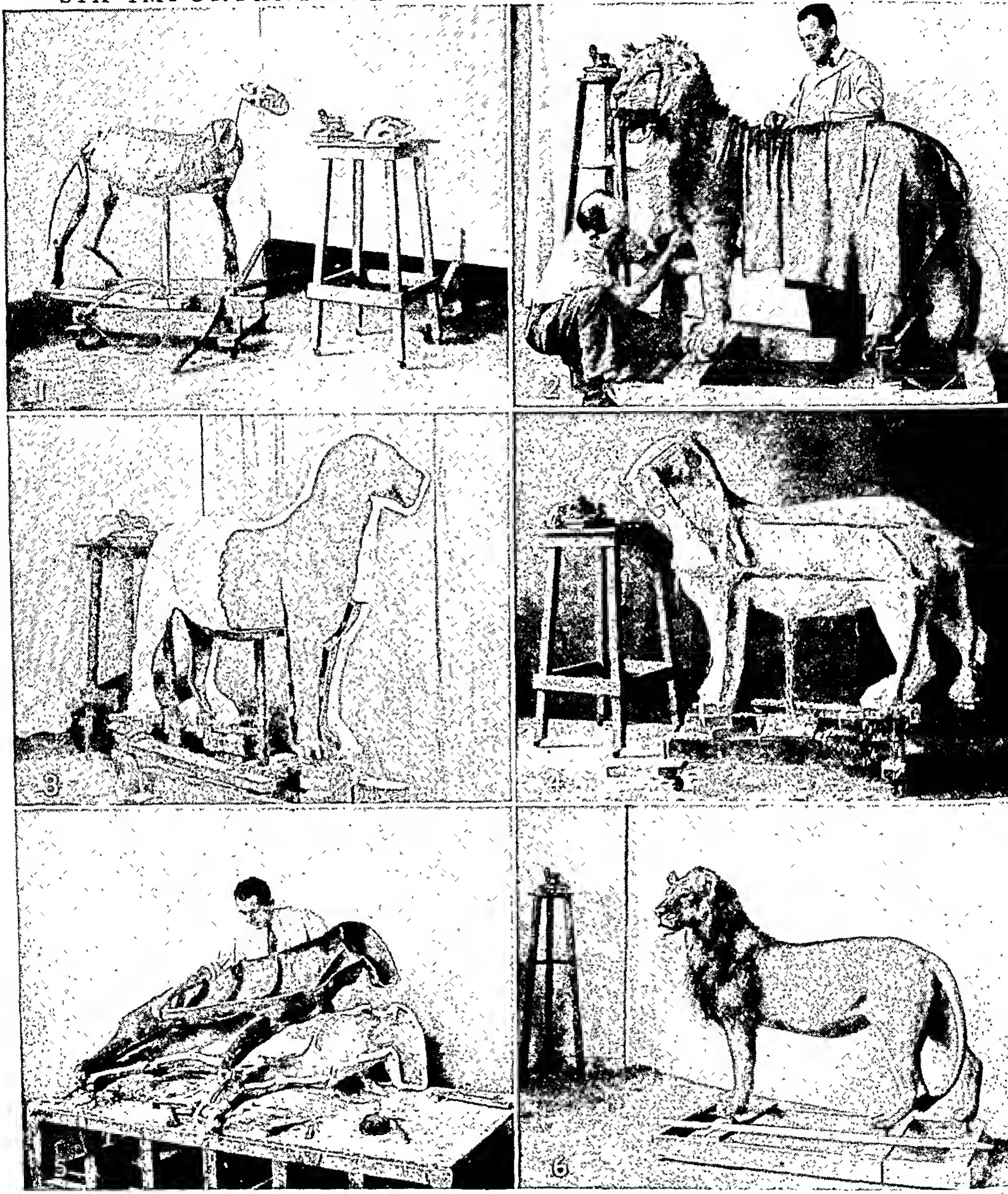
TAXIDERMY. If you go into a great museum of natural history today you will find beautiful specimens of birds, beasts, and reptiles preserved and mounted in natural positions. Cleverly constructed settings reproduce the animal's natural surroundings. You can see tiny hummingbirds hovering over flower clusters; great cranes asleep amid reeds, one leg tucked close to the body; monsters of the prehistoric period stalking through ferns as tall as trees; a leopard mother asleep in the jungle with her cubs around her; and great boa constrictors coiled about tree branches, lying in wait for the unwary deer.

Such triumphs of modern *taxidermy*, the art of preserving and mounting animals, demand knowledge, skill, and artistry. Formerly specimens were merely cleaned and skinned. The skins were then stuffed, often by persons with little skill or imagination. The results were often unlike the living animals. Now

BRINGING THE DEAD BACK TO "LIFE"

This giant panda is a splendid example of the art of taxidermy. The animal has been given a lifelike appearance amidst a setting that faithfully depicts every detail of its native home high in the mountains of central Asia.

SIX IMPORTANT STEPS IN "CREATING" A MUSEUM LION



1. First taxidermists fashion a framework of rods and wood and cover it with papier-mâché and strips of screening. Clay is laid over this and modeled to the exact form of the animal. 2. The skin is tried on the clay model. 3. This model is now encased in plaster. 4. The plaster, reinforced with braces, dries to form a hard shell. 5. Cut away from the clay model, the two halves of the plaster shell now serve as models to fashion the final figure or "manikin." This is made of burlap and glue for lightness and strength. 6. After the parts of the manikin have been joined, the skin is glued on, and we see a lifelike animal, with the scanty mane typical of lions that live in the brush-covered wilderness.

taxidermy has been transformed from a crude handicraft to an elaborate, specialized, and exacting art.

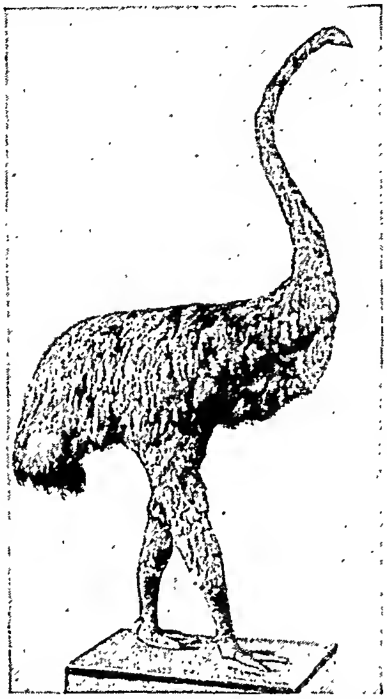
The outstanding taxidermists of today are both scientists and craftsmen. They study the habits and the natural positions of live animals. They know the structure of animals inside and out. They are able to sketch, mold, and carve. They are dyers and painters, and tanners of skins. They are photographers who take pictures of live animals in their native environment to be used as guides in their work. They

do a large amount of research, particularly into the properties of new plastics that may prove useful to them.

The new school of taxidermists has done away entirely with the old "stuffing" idea. To provide the "insides" of an animal specimen a framework of wire is covered with clay, plaster, or papier-mâché, and modeled in the desired pose as carefully as if it were a sculptor's model. From the model a light cast is made. Over this dummy or "manikin," as taxidermists call it, the skin is then fitted and carefully molded to follow the outlines. In the case of the larger mammals, the nostrils, mouth, and tongue are truthfully reproduced in some material easily molded. The crude glass eyes formerly used have been replaced with hollow globes painted in startlingly close resemblance to the natural eye. The larger birds and fishes are mounted in a similar manner.

Patience and delicacy of touch are qualities needed by the successful taxidermist. One of the most difficult and wearisome processes is the removal of the skin in such manner as to disfigure it as little as possible. With sharp knives and scissors the taxidermist makes an incision at the proper place, usually along the stomach, and then patiently works the skin loose bit by bit until it comes off whole. Preservatives, such as arsenical soap or a mixture of burnt alum and saltpeter, are then carefully worked into the skin to keep it from spoiling. Some of the most famous taxidermists in the world are found at the American Museum of Natural History in New York City, the National Museum at Washington, D. C., the Chicago Natural History Museum, and the California Academy of Sciences at San Francisco.

A MOA "COMES TO LIFE"



The moa, which was sometimes 10 to 12 feet high, lived centuries ago in New Zealand. Only a skilled taxidermist could rebuild his body from fossil bones so it looks alive.

Perhaps the highest development of the taxidermist's art is the restoration of fossil animals. This work often requires a knowledge of geology and of the evolution of animal life through the ages, as well as an intimate study of the anatomy and habits of living animals whose structure is similar to that of the extinct species. In many cases, when only a part of a skeleton has been found, the taxidermist must laboriously build up the missing parts, calling upon a vast store of technical knowledge to aid him.

"Old Rough and Ready"—FIGHTER *and* PRESIDENT

TAYLOR, ZACHARY (1784–1850). General Zachary Taylor, the 12th president of the United States, was the first man to be elected to that high office with no previous political training, and he was the third to be chosen because of his military exploits. Like Andrew Jackson, Taylor was a frontiersman. He was born in Virginia, but the family had migrated to Kentucky before he was a year old. There he grew up with little schooling, for schools were unknown in that region when he was a boy. But around the fireside frequently gathered his father's comrades of Revolutionary days. It is probable that the conversation at such times inspired in him and his brothers the desire to be soldiers, for four out of the five boys entered the army.

TAYLOR'S ADMINISTRATION 1849–1850
Gold Rush to California (1849).
Clayton-Bulwer Treaty with Great Britain guaranteeing neutrality of the proposed Nicaraguan Canal (1850).
Senate Debates on Clay's Compromise (1850).
Death of President Taylor (1850).

Zachary obtained in 1808 a commission as first lieutenant in a recently formed regiment of United States troops. His service in the army covered a period of 40 years, extending to the time when he was elected president. During that time he served in the War of 1812, against the Indians in the Northwest and in Florida, and in the Mexican War. On the Northwestern frontier he aided in the campaign against Black Hawk, and was the officer to whom that warrior surrendered in 1832.

In 1846 General Taylor was ordered to occupy the disputed territory between the Rio Grande and Nueces rivers in Texas. Both Mexico and the United States claimed this territory, and as soon as Taylor moved into it he was attacked by the Mexicans. As a result of this attack, Congress declared war on Mexico on the ground that "American blood had been shed on American soil." After Taylor had won a victory over the Mexicans at Monterey, President Polk, who distrusted Taylor's views against the war, sent General Scott to Mexico as chief commander, and gave most of Taylor's troops to the new general. Santa Anna, the Mexican commander, learning of Taylor's weakened condition, immediately attacked him at Buena Vista; but after an all-day battle "Old Rough and Ready," as Taylor was called by his troops, won the day. This victory, won against such odds, fired the public imagination and made Taylor the hero of the hour. He was immediately mentioned as a possible candidate

in the presidential election to be held in the next year, 1848.

But Taylor, having been a soldier all his life, had not voted, much less allied himself with either party. As a result, both parties wished to secure him for their candidate. At first Taylor discouraged all political demonstrations in his behalf, but he finally yielded and set forth in a letter his views on the important questions of the day. This letter proved acceptable to the Whig leaders. Remembering their victory in 1840, when General Harrison was their candidate, they were glad to secure another military hero as their standard bearer. His running mate was Millard Fillmore, a New York Whig, who succeeded to the presidency upon Taylor's death. Taylor had, a few years before the Mexican War, purchased a plantation in Louisiana. This plantation, which was worked by slaves, and Taylor's connection with Jefferson Davis, who was his son-in-law, won for him many southern votes, and he was triumphantly elected over Senator Lewis Cass, the Democratic candidate.

ZACHARY TAYLOR

After Taylor was inaugurated, however, he proved to be less southern in his views than some had hoped. He advised that California form a state government and decide on her own institutions; and when that state asked to be admitted as a free state, he recommended that Congress grant the request. He also took steps to prevent secession when this move was threatened by the South. In foreign affairs his secretary of state, John M. Clayton, negotiated the Clayton-Bulwer treaty with Great Britain, which paved the way for a Panama Canal constructed by the United States.

Unfortunately for the country, President Taylor died after only 16 months in the presidential chair, and while the historic debates on the Clay compromise were still under way (*see* Compromise of 1850). Many people believe that if he had lived the slavery controversy might have been adjusted. Senator Benton said of him: "No man could have been more devoted to the Union or more opposed to slavery agitation; and his position as a southern man and a slaveholder, his military reputation, and his election by a majority of the people and of the states would have given him a power in the settlement of these questions which no president without these qualifications could have possessed." Taylor did not approve of some features of the Compromise of 1850.

Zachary Taylor was an honest, determined man. As president he had no political friends to reward or enemies to punish. It was because of this separation from politics that he had so great an influence, and also because he chose for his advisers men who could supplement his own common sense and make up for his lack of political experience.

MAKING *the* WORLD'S *Most* POPULAR DRINK

TEA. When tea drinking was first introduced from Asia into England in the 17th century, many opposed it vigorously. One man in a moment of heat denounced it as a "base unworthy Indian practise, and a filthy custom." But the use of tea increased steadily, and before the second World War the British Isles imported about 11 pounds for every man, woman, and child every year to keep the national teapot going. The New Zealanders, Australians, and Canadians were not far behind. The Chinese, Japanese, and Tibetans, however, were the greatest tea drinkers of all; and the Russians long ago adopted the habit from their eastern and southern neighbors. The people of the United States, preferring coffee, consumed annually less than a pound apiece. The spread of military operations in Asia and the Southwest Pacific during the second World War cut off the importations of tea from that area, and the per capita consumption elsewhere was greatly reduced for the duration of the war.

Tea as we know it is the dried and prepared leaf of several varieties of evergreen shrubs or small trees which have been cultivated in China and India for more than 2,000 years. About 1840 the British began to grow tea on their own plantations in India. The improved methods of cultivation and preparation which they introduced made India the principal tea-exporting country in the world. China still grows more than any other country—about 50 per cent of the total world production—but most of its tea is consumed at home, so that in exports it is surpassed by India, Ceylon, and Java and Sumatra. Japan and Formosa are the only other considerable sources of supply. Tea has been grown in North and South Carolina, but

PLUCKING TEA LEAVES ON A PLANTATION IN JAVA

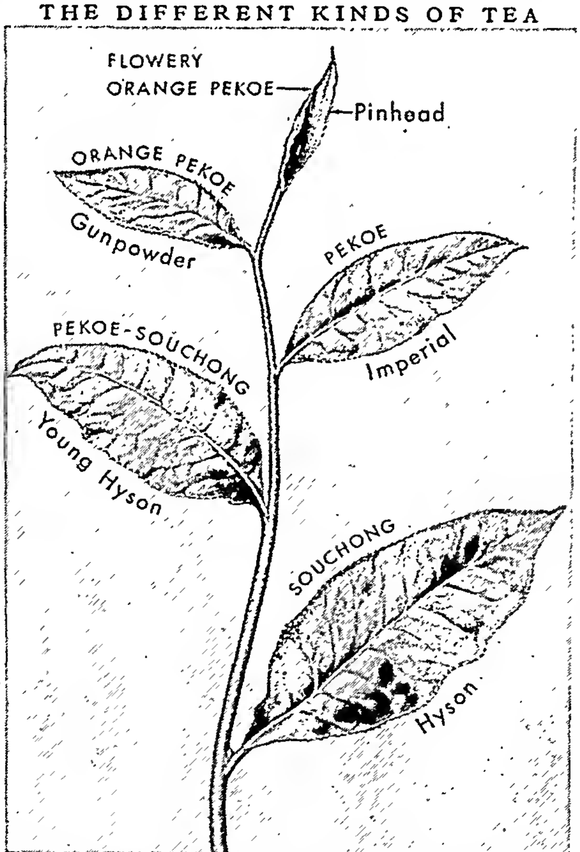
These women tea pickers have just filled their sacks in one of the gently rolling fields of Java so well suited to the growing of the tea plant. The bushes are kept pruned to a height convenient for women and children, who do most of the picking.

the higher cost of labor makes competition with Asiatic countries impossible. French Indo-China and the British possessions of Nyasaland and Kenya in Africa grow small quantities. Assam, a province of India, is perhaps the original home of the tea plant, since one variety grows wild there.

Tea thrives best at moderately high altitudes in a warm moist climate. On the plantations of Ceylon and India, hundreds of acres are covered with the gray-green foliage of tea plants, set out in rows four feet apart or more. The wild plants grow to the size of small trees, but in cultivation they are pruned to a height of three to five feet.

Tea plants in bloom show a profusion of scented white or pinkish blossoms. These look very much like little wild roses, with petals encircling a cluster of yellow hairlike stamens tipped with pollen; the petals, however, are thick and waxy. The leaves are leathery and lancet shaped, with saw-toothed edges. Look at one of the open leaves left in the teapot after the tea is poured and you will see how much it resembles a rose leaf. The leaves when fully grown are three or more inches long, but as only the bud and three or four leaves are plucked, we find none as long as two inches in our packages of tea. The plants are ready for the first picking when they are about three years old. At that time they are sending out an abundance of young leaf shoots, known as the "flush," and these are picked. As new shoots grow on the twigs, another crop is gathered. In Ceylon, Java, and Sumatra, where it is always summer, the flush is ready for picking about every ten days, but in the colder parts of India, China, Japan, and Formosa, there are only three to five pickings a year. Unskillful or careless picking yields tea of poor quality. The tea pickers carry big baskets or bags hanging from their head or shoulders. Their trained eyes single out from the wealth of foliage the tender young shoots, and they deftly break off the tops at just the right place and toss them into their baskets, apparently with one motion of the arm.

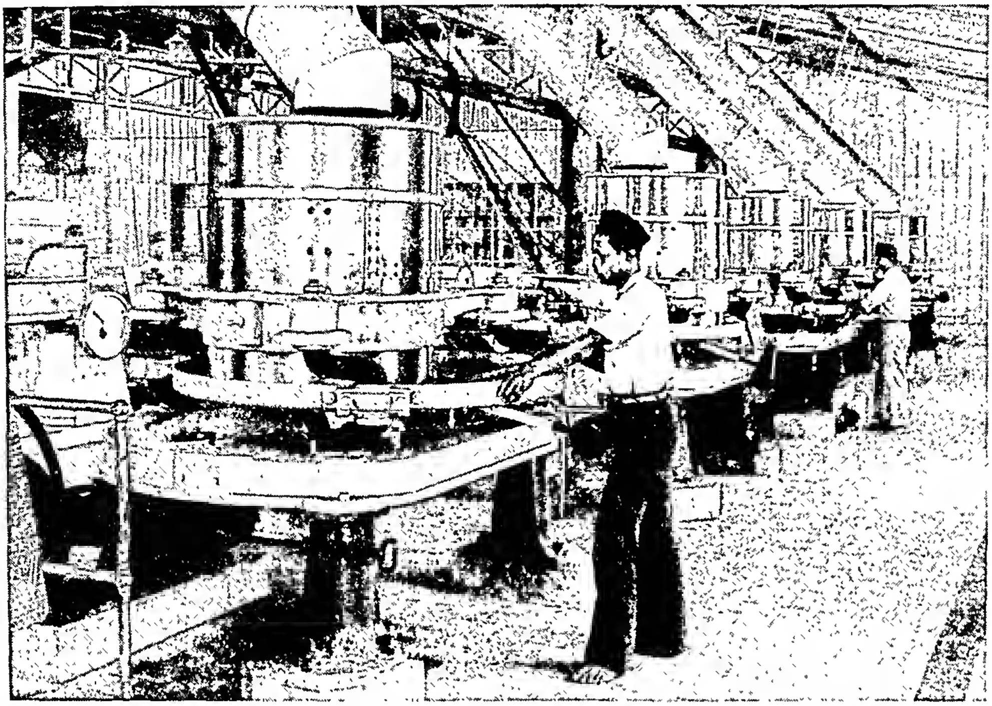
THE DIFFERENT KINDS OF TEA



Teas get their trade names, not from different tea plants but from the position of the tea leaves on the stem. The nearer the tip, the better the grade. The names above the leaves are used for black teas; those below, for green or Chinese teas. Variations in quality may be due also to the character of the plants themselves and the districts where they grow. A plain pekoe from one plantation, for example, might excel an orange pekoe from another.

Quality in tea is determined not only by the size of the leaf, but by the elevation of the garden in which it is grown and the care taken in fertilizing and cultivating. The flavor is

THESE MACHINES STIR THE TEA LEAVES



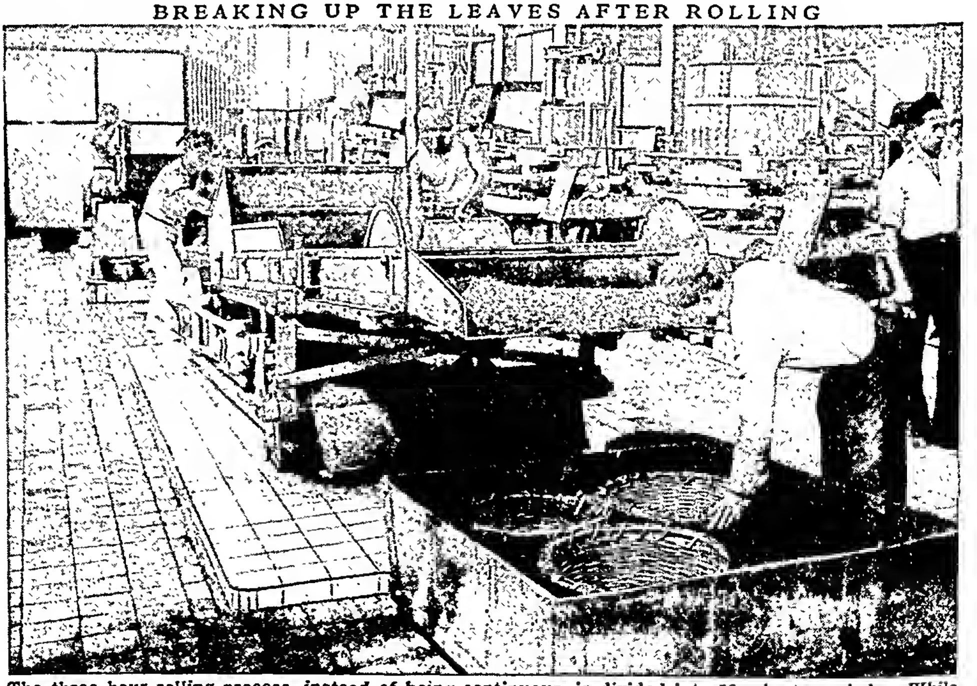
In this picture we see a section of the rolling room in one of the tile-floored, modern tea factories of Sumatra, which produces much of the world's black tea. After the leaves have been softened by the withering process in the lofts upstairs, they are poured down chutes into these shiny rolling machines, which resemble old-fashioned grinding mills. The leaves are stirred around for about three hours to break up their cells and release their juices.

due to the method of curing and to the essential oils in the leaf, but its stimulating and refreshing qualities come from the small percentage of *thein* which it contains. Thein is chemically the same as caffeine, which occurs in coffee, cocoa, Paraguay tea (*yerba maté*), and the cola nut. Chemically it is an alkaloid which acts as a mild heart and brain stimulant. It may be dangerous if taken in excessive quantities. The percentage of tannin in tea is small. The beverage smells and tastes best when the leaves are steeped in boiling water, but not boiled.

How Tea is "Cured" for Market

Green tea and black tea are made from the leaves of the same plant by different processes of manufacture.

BREAKING UP THE LEAVES AFTER ROLLING



The three-hour rolling process, instead of being continuous, is divided into 30-minute periods. While being stirred, the moist leaves cling together and form large balls which have to be broken up. After each "roll," the matted leaves are dumped into the machine shown here, which passes the leaves along with a jouncing motion that shakes them apart. Then the unscrambled leaves are collected in baskets and put back into the rolling machine for more stirring.

The first step in curing black tea is *withering*, which takes place in large lofts of the tea factory. The leaves are spread out on racks exposed to the outside air. There they stay for about 24 hours, at the end of which time they are as soft as velvet.

When the withering is finished, the next step is *rolling* the leaves. This is done either by hand or by machine. The purpose of rolling is so twist and crush the leaves that their juices come to the surface. Then the leaves are ready for the *fermenting* process. The temperature in the fermenting room is lower than elsewhere in the factory, the air is very moist, and the sunlight is shut out. The leaves are spread on the floor or on tables and remain there

about four or five hours. By that time oxidation has changed the leaves to a golden brown, and they give out a pleasant aroma like that of ripe apples.

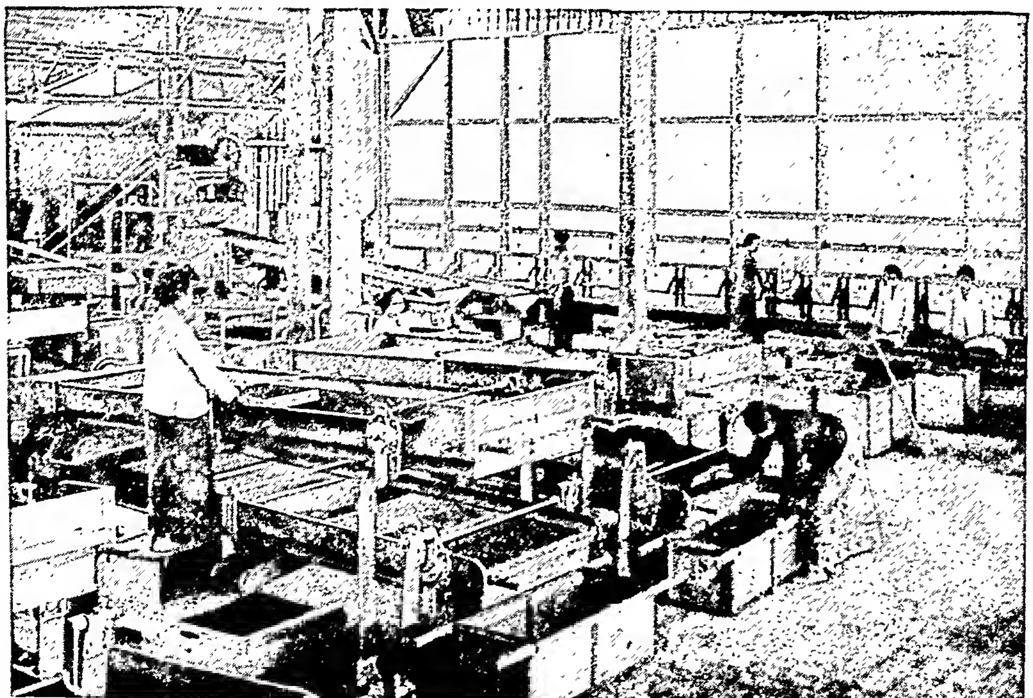
After fermentation, the leaves go to the *firing* room, where hot air at temperatures ranging from 220° to 250°F. passes through and over them for half an hour. In India, Ceylon, and Java, where most of the black tea is made, the firing is done with a machine which moves a chain of trays over the fire in the firing room.

SORTING OUT IMPERFECTLY TREATED LEAVES

After the final roll, the leaves are put into the darkened fermenting room, where they stay about four or five hours while oxidation changes their color to a rich brown. Then they are dried in the ovens of the firing room until they turn black and almost all moisture is removed. The leaves next go into the sorting room shown above, where sharp-eyed girls remove stems and leaves not properly cured.

Finally the blackened and dried leaves are ready for *grading.* The various grades of tea are determined by the size of the tea leaf. The leaves are dumped in heaps on the floor of the sorting room, where the stalks and the insufficiently treated leaves are removed. The tea is then sorted into grades by a machine that shakes it through screens of varying mesh.

SEPARATING THE LEAVES INTO GRADES

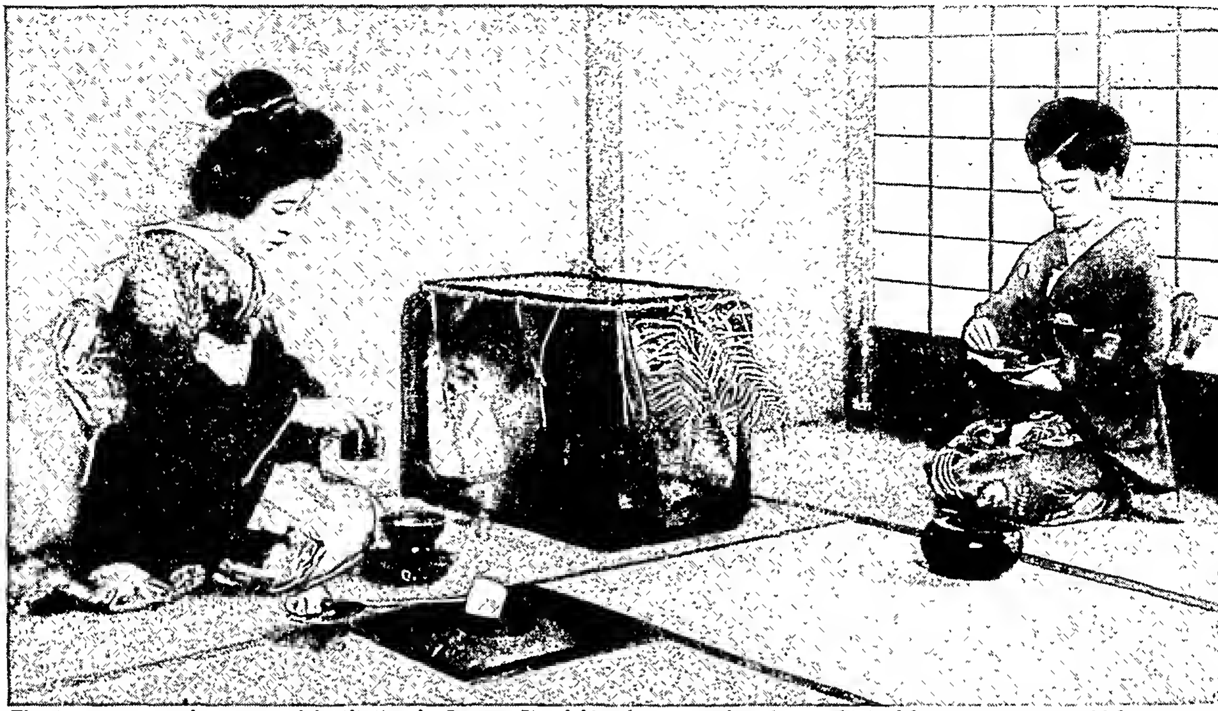


Finally the leaves are ready to be sorted into the various grades, which are based on their different sizes. The smaller and tenderer the leaf, the better the tea. Much of the grading is still done by hand, but machines like the ones shown here are more and more supplanting hand methods. A series of moving screens, each with a different size of mesh, sorts and distributes the leaves into separate containers. Then the tea is packed for shipment.

Green tea is unfermented tea, and comes from Japan and China. It is steamed immediately after picking to seal the leaf and prevent the sap from fermenting. Then it is lightly rolled and twisted, and finally fired. Modern machinery is rare in China, and in Japan its use is still somewhat limited, so green tea is generally rolled and twisted by hand, and fired in tall baskets or great copper pans over a charcoal fire. It is called "basket fired" or "pan fired" according to the method used.

Japanese scientists who conducted experiments with green

THE "CHA-NO-YU," OR TEA CEREMONY



The tea ceremony is a revered institution in Japan. Its rigid rules governing the conduct of host and guests, which were prescribed hundreds of years ago, reflect the great influence of tradition on the Japanese way of thinking and living.

and black teas declare that green tea contains some vitamin C.

Oolong tea, a favorite in America, is a slightly fermented tea, cured chiefly on the island of Formosa.

Tea is given a special firing when it is ready for export. It is packed in lead-lined boxes to protect it from the salt sea air, which would spoil its flavor.

Since tea absorbs odors readily, it is sometimes perfumed in China and Formosa. Layers of jasmine flowers are spread on top of the tea for a few hours, or sometimes they are fired together. The flowers are later sifted out in some varieties.

Brick tea, made of tea dust and broken leaves steamed and pressed into cakes, is exported to Russia. A coarse brick tea, made of leaves and stalks, is sent to Tibet and Mongolia, where it passes as currency. Tibetans add soda, butter, and salt to their tea.

Tea Ceremony in Old Japan

Tastes in tea flavors and tea-making customs vary around the world. The Chinese and Japanese like best the unfermented teas, which produce a straw-colored drink. Customs dating back to the Middle Ages go to make up the Japanese tea ceremony, which is held in a room specially built for the purpose. In the picture at the top of this page we see a hostess preparing tea for a guest. On the hearth is a jar of hot water with a bamboo dipper resting on the lid. After rinsing the tea bowl the hostess places in it some powdered tea from a small lacquered caddy. Pouring a dipper of water over the tea, she beats the mixture to a froth with a bamboo whisk. The guest, meanwhile, is eating sweets. She places them on a piece of paper which she has brought with her. Hostess and guest may drink from the same bowl or each may have one. In the cabinet between them are utensils for a more elaborate tea ceremony.

Black tea is the choice of the British, the greatest tea drinkers of the Western world. They usually add milk and sugar to the cup. Everyone takes time off for afternoon tea in England. Americans once preferred green teas, but today fermented varieties are becoming increasingly popular.

The Russians seldom use milk or sugar, but usually add a slice of lemon or some spice. In Switzerland cinnamon often is steeped with the leaves. An infusion of tea and mint is a favorite beverage in North African countries. In Turkestan fermented tea is boiled until nearly black, then cream is added. Bread is soaked in the liquid and eaten. The Persians boil their tea and add spices.

"Yerba Maté" and Other "Teas"

There are a number of plants whose leaves are used in preparing tealike drinks. The most important of these probably is "Paraguay tea" or *yerba maté*, which is made from the leaves of a species of holly found in Brazil and Paraguay. Maté has an agreeable, slightly aromatic odor and a somewhat bitter taste. The Indians of North Carolina prepared a tea called "yaupon" from the leaves of another hollylike tree or shrub. It resembled strong black tea, with an odor not unlike oolong, and it was extensively used in Revolutionary times as a substitute for China tea in the tea-tax days. A tea is also prepared in Peru and Bolivia from the dried leaves of the cacao tree. Trinidad tea is prepared from a decoction of the leaves of the pimento or allspice tree, and is in common use in

Trinidad and other islands of the West Indies, both as a beverage and as a medicine. Coffee-leaf tea is used in many coffee-growing countries, the natives often preferring it to any decoction of the berry. Every pioneer family was familiar with the "sassafras tea" prepared from the aromatic roots and bark of the sassafras tree, and with "cambric" tea, a mixture of cream, sugar, and hot water.

The scientific name of the tea of commerce is *Camellia thea*, of the family *Theaceae*. The chief varieties are *bohea* and *viridis*. There has always been a dispute as to the original home of the plant, but most botanists now believe that it is native to the whole monsoon region of eastern Asia. To make the tea blends preferred by the palates of many lands, delicate testing and blending is necessary. Expert tea testers can tell the country, altitude, climate—and sometimes the individual garden—in which the tea was grown, by tasting, smelling, and examining beverage and leaves. Government experts set the standards for teas to be accepted into United States ports each year.

TEAK. One of the finest of all woods comes from the teak, a tree of India which must be at least a hundred years old before it is ready to be cut for timber. It grows in scattered patches, very rapidly at first, and mixed with a dense growth of other kinds of trees, many of them larger than itself. When fully grown it may be 140 feet in height, with a straight trunk of perhaps 60 feet. This produces a log of valuable length, but one not always solid at the core. The teak of more open country grows less rapidly, but produces the finest quality wood, dense and solid.

The teak is a deciduous tree, that is, one that sheds its leaves periodically. It has long rough leaves, one or two feet in length. Its small white flowers grow in clusters at the ends of the higher branches. The fruit is a hard-shelled nut, with four seeds which do not germinate readily. The light nuts are easily washed into the rivers by rains, so there are few seedlings in a forest of teak. With a little care of the seed and protection of the young trees, however, they are easily cultivated. They grow best in rich moist soil, on the banks of streams, near the sources.

The tree is not cut until it is at least six or eight feet in girth, and often as much as two hundred years old. It is first girdled by cutting through the bark and sapwood completely around the trunk; then the tree stands for two or three years until it is dry enough to be floated downstream to the ports. Green teak is too heavy to float.

A resinous oil in the wood gives teak an aromatic fragrance, especially when green, and extraordinary durability; the oil also protects it from insects and fungi, and prevents the rusting of iron in contact with it. Teak does not warp or crack when seasoned, and teak timbers in old buildings have been found almost unchanged after centuries. Bits of teak found in Indian caves are over 2,000 years old. It is the best of all woods for shipbuilding. Since it is not very hard, is easily worked, takes a good polish, and is a golden-brown color, darkening with age, it is also one of the finest woods for cabinet work.

The teak is native to India, Burma, Thailand (Siam), Java, and Sumatra. It grows also in the Philippine Islands and other tropical countries. Some is shipped to Europe and the United States, mostly from Burma, but most of it is used in the Far East. Scientific name, *Tectona grandis*.

TECUMSEH'S SENSE OF FAIR PLAY IS OUTRAGED

Tecumseh comes to confer with General Harrison at Vincennes. As in most conferences with the whites, the Indians knew they were at a disadvantage. Honest and fair-minded himself, Tecumseh angrily raises his tomahawk when Harrison refuses to return vast tracts of land taken from the Indians. "Sell a country!" he cries. "Why not sell the air, the clouds, the great sea as well as the land?"

TECUM'SEH (1768–1813). Of all the struggles of the Indians to hold their lands against the white men, the most dramatic was the one which had for its leader the great Shawnee chief, Tecumseh. Born on Mad Creek, near the present city of Springfield, Ohio, about the year 1768, he had from his earliest childhood seen suffering brought to his people by the whites. Year after year he beheld his people deprived of their homes and pushed farther and farther back from their

fields and hunting grounds in the Ohio River valley. He also saw them demoralized by alcoholic liquor sold to them by white traders.

Tecumseh believed that the Indians' only hope lay in reviving Indian morality and uniting against the white invaders. In 1808 he and his brother Tenskwatawa, a religious leader called The Prophet, established a village near the mouth of the Tippecanoe River in northern Indiana. They persuaded the Indians there to avoid liquor, to cultivate their land, and to return to traditional Indian ways of life. The village came to be known as Prophet's Town.

Meanwhile Tecumseh was forming a great defensive confederacy of Indian tribes. He was a natural leader and an inspired orator. "Our fathers," he said to the Indians, "from their tombs, reproach us as slaves and cowards. I hear them now in the wailing winds." He won the allegiance of many tribes. Prophet's Town became their headquarters and gathering place.

At that time William Henry Harrison was governor of the Indiana Territory. He induced a number of individual tribes to give up great areas in the region which is now Indiana and Illinois (*see* Harrison, William Henry). At a council in Vincennes in 1810 Tecumseh demanded that land be returned to the Indians. Since it belonged to all of them, he argued, individual chiefs did not have the right to barter it away. His demand was rejected. He then traveled to Canada to consult the British and afterward to the Southwest to enlist support of Indian tribes there.

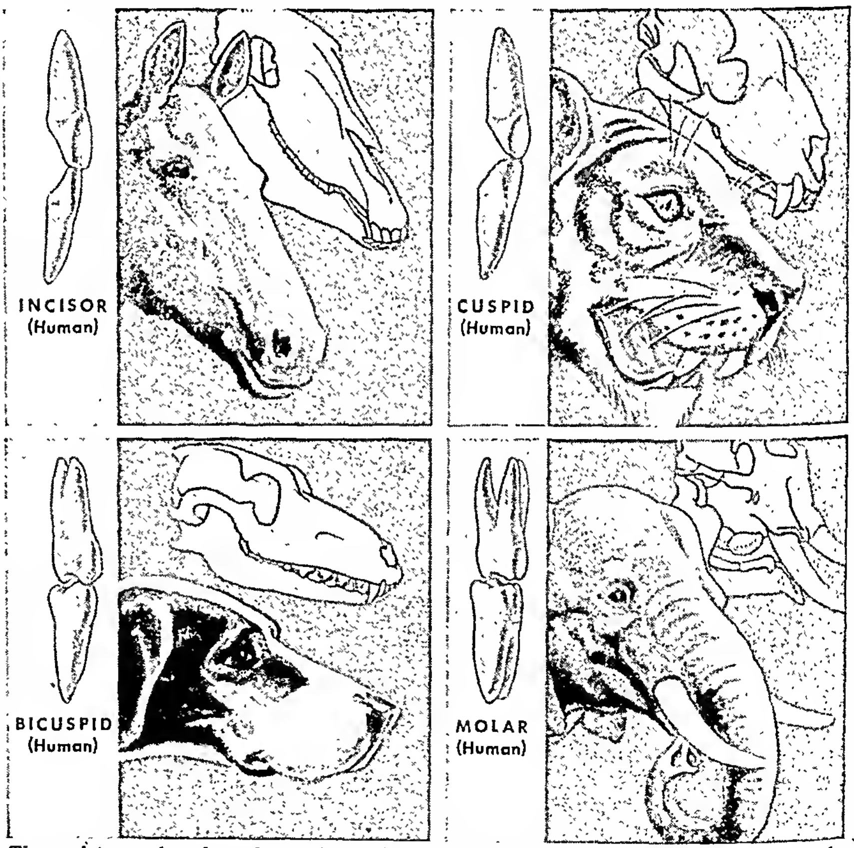
Governor Harrison undertook an expedition against Prophet's Town during Tecumseh's absence, in September 1811. On November 7, after a fierce battle, he destroyed the village. This defeat scattered the Indian warriors. When the War of 1812 broke out, Tecumseh joined the British as a brigadier general. He was killed at the battle of the Thames, in Ontario Oct. 5, 1813. He is buried on Walpole Island, Ont.

ONE *of Our* PRECIOUS *Possessions*—TEETH

TEETH. By cutting, tearing, and grinding food and by helping to mix it with saliva, teeth carry out the first step in digestion. This is known as mastication (*see* Digestion). The teeth of human beings also help to form the sounds of speech and to determine the facial expression.

Teeth of different shapes do different work during the eating process. *Incisors* (the front teeth in the human mouth) have sharp chisel-shaped edges. These teeth bite and cut. *Cuspids* (the canine, or dog, teeth) are pointed teeth for tearing and shredding. *Bicuspids* are double-pointed teeth which both tear and grind. *Molars* have broad, uneven surfaces for crushing and grinding.

The structure of animals' teeth varies according to the kind of food they eat. Plant eaters usually have well-developed incisors for biting off grasses and grains. They also have strong molars for grinding, because plant foods require considerable softening by mastication. Beasts of prey, which live on other animals, have long, strong cuspids for piercing and tearing. They have few or no molars, because flesh is easily digested without much chewing. Human beings eat both plant and animal foods, and so they have teeth of all four types, all about equally well developed.



These pictures show how the teeth of animals correspond to the four types of human teeth. Note the prominent incisors of the horse, a grass eater, and the well-developed cuspids of the tiger, a meat eater. The dog, which eats chiefly animal foods, has four bicuspids on each side in each jaw; these teeth tear and crush. The elephant, a plant eater, has long incisors (his tusks) suitable for rooting and powerful molars for grinding.

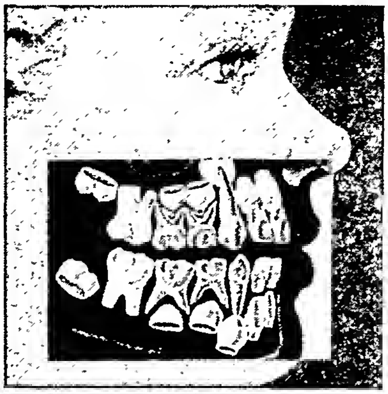
Human beings grow two sets of teeth. The first set serves during infancy and childhood. These teeth are known as the *primary*, *milk*, *temporary*, or *deciduous* teeth. They are gradually replaced by a second set. These are the *permanent* teeth.

All the teeth develop from cellular "buds" inside the jaws. The buds of both the milk teeth and the permanent teeth form long before the baby is born. From the bud, the *crown* develops first. This is the hard, enamel-covered part which will later become visible in the mouth. When the crown is fully grown and hard, the root starts to develop. The crown is complete and the root about two-thirds formed when the tooth *erupts*, or pushes through the gum.

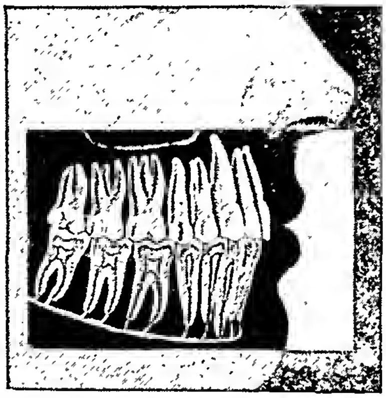
A baby's first tooth usually erupts when he is six to nine months old. Primary teeth continue to appear for two or three years until he has 20 teeth, 10 in the upper and 10 in the lower jaw. In the meantime the permanent teeth are forming within the jaws. By the time a permanent tooth is ready to replace a milk tooth, the root of the milk tooth has been absorbed by the tissue of the jaw. That is why milk teeth are often thought to have no roots.

There are 32 permanent teeth. The first to appear are the first permanent molars, called the six-year molars because they usually appear at that age. The last to appear are the third molars, or "wisdom teeth." The diagrams below show the arrangement with the usual dates of eruption of the two sets of teeth.

TEETH OF CHILD AND ADULT



Here we see the milk teeth (in darker tone) and the developing permanent teeth at the age of six years.



Here are the permanent teeth with the jaws closed to show the "bite." The lower teeth are seen in vertical section.

When the teeth in a normal mouth are brought firmly together, the upper incisors slightly overlap the lower incisors. The rest of the teeth bite together, each upper tooth against its mate in the lower jaw and also against the lower tooth toward the back.

The bite is called *occlusion.* If the teeth do not bite together properly the condition is called *malocclusion.* This may interfere with the ability to chew efficiently as well as with the symmetry of the face. *Orthodontists* are dentists trained to correct malocclusion by straightening crooked teeth.

Teeth Are Valuable—They Need Care

Care of the teeth includes eating the right kinds of food. During infancy and childhood the food must provide the materials with which the body builds teeth. The diet should include plenty of milk, eggs, whole-grain cereals, fruit, and vegetables to supply minerals and vitamins. Calcium, phosphorus, fluorines, and vitamins A, C, and D are especially important. A good supply of vitamins A, B, and C is necessary throughout life for healthy gums. (*See also* Food.)

The chief enemy of teeth is decay, or *dental caries.* This is believed to be due indirectly to a certain kind of bacteria which are normally present in the mouth. They ferment sugars and starches (carbohydrates) and in doing so make acid. The more sugar and starch we eat the more numerous they become and the more acid they make. This acid may eat through the enamel of a tooth. Acid and bacteria then attack the ivorylike *dentine,* which forms the body of the tooth. If decay works through the dentine, it reaches the *pulp.* This is soft tissue at the center of the tooth. It contains blood and lymph vessels and nerves. If bacteria enter the pulp, infection may make removal of the tooth necessary.

Moderation in eating sugars and starches tends to cut down tooth decay. So does brushing the teeth immediately after eating. Brushing should be done away from the gums, not toward them. Dentifrices containing preventive substances, such as ammonium or penicillin, may reduce decay. However, their real value is not yet known.

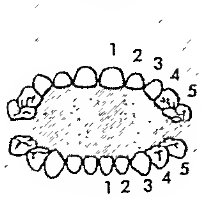
Application of sodium fluoride solution to the teeth of children beginning at about the age of three years helps the teeth resist decay. Adding fluorides to community water supplies containing an insufficient amount of these substances may be beneficial.

There is only one remedy for tooth decay once it occurs—a visit to the dentist. He cleans out and fills the cavity to keep decay from progressing. Visits to the dentist should begin as soon as the milk teeth have all erupted. They should continue at intervals of six months or less. The dentist not only

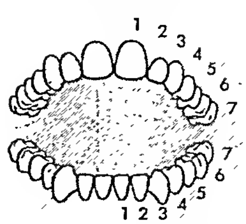
OUR TWO SETS OF TEETH AND WHEN THEY APPEAR

NAME OF TOOTH	AGE, MONTHS Upper	Lower
1. Central incisor	7½	6
2. Lateral incisor	9	7
3. Cuspid	18	16
4. First molar	14	12
5. Second molar	24	20

TEMPORARY



PERMANENT



NAME OF TOOTH	AGE, YEARS Upper	Lower
1. Central incisor	7–8	6–7
2. Lateral incisor	8–9	7–8
3. Cuspid	11-12	9-10
4. First bicuspid	10-11	10-12
5. Second bicuspid	10-12	11-12
6. First molar	6–7	6–7
7. Second molar	12-13	11-13

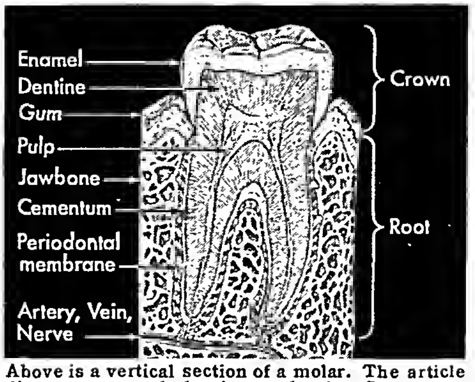
The chart at the left shows the teeth of a child 2 to 2½ years old. That at the right shows the teeth at 11½ to 12½ years; all the teeth have appeared except the third molars, or "wisdom teeth," which normally erupt between the ages of 17 and 21 years.

looks for cavities and fills them but cleans the teeth and treats other abnormal conditions. The milk teeth need this care as much as the permanent teeth. They serve a double function: they are necessary to mastication during childhood, and they hold places in the jaws for the permanent teeth.

Evolution of Teeth

In the story of evolution, teeth related to human teeth appear first in a fossil ancestor of the shark known as *Cladoselache (klăd-ō-sĕl'ȧ-kē)*. The skin of Cladoselache, like that of the shark today, was covered with denticles ("little teeth") composed of enamel with a core of pulp. The teeth were similar structures set into the skin of the jaws. The teeth of all the animals with backbones (*vertebrates*) are thought to have evolved from these teethlike denticles, the simplest ones being those of the shark (*see* Sharks).

INSIDE VIEW OF A TOOTH



Above is a vertical section of a molar. The article discusses enamel, dentine, and pulp. Cementum is a bonelike layer. The periodontal membrane helps hold teeth firm and is a shock absorber.

In the lower vertebrates, the teeth are set into gums but are not attached to the jawbones. New sets of teeth grow in as often as the old ones wear out. In mammals, whose teeth have evolved farther from the original denticles, the teeth have roots in the jaws. They are replaced only once, as in man, when the first set, the milk teeth, is succeeded by the second set, the permanent teeth.

The FLASHING WIRES *That* GIRD *the* EARTH

TELEGRAPH. When George Washington died it was weeks before the news reached some of the remoter settlements of the United States. Today every important event that occurs anywhere in the United States or the great cities of the world is flashed to every other city in the remarkably short space of a few seconds or minutes.

For thousands of years men have been experimenting with methods of telegraphing (from the Greek words meaning "to write at a distance")—that is, sending news by signals to distant places. Earliest of these devices was the signal light or beacon fire. You recall how Paul Revere, before starting on his midnight ride, arranged lantern signals from the belfry of Old North Church tower to tell of the coming of the British—"one if by land, two if by sea." When the great Spanish Armada threatened to land on England's shore, beacon fires were lighted on the hills of England's seacoast to summon the defenders.

Sunlight flashed from mirrors of glass or polished metal according to code signals is another ancient device for telegraphing. Napoleon used these light signals, or "heliographs," for communicating military orders, especially in his Egyptian campaigns. North American Indians made use of puffs of smoke, made by holding blankets over fires and releasing them at intervals. Semaphore signals with arms at an angle, somewhat like signals used by railroads today, were quite generally used in Europe during the 18th and early 19th centuries, especially in France and Russia.

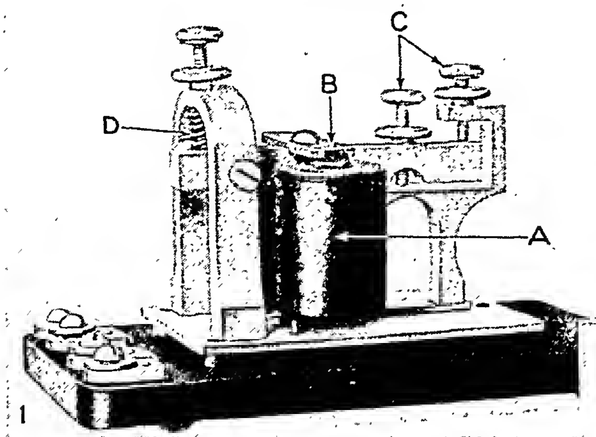
THE TELEGRAPHER'S ALPHABETS

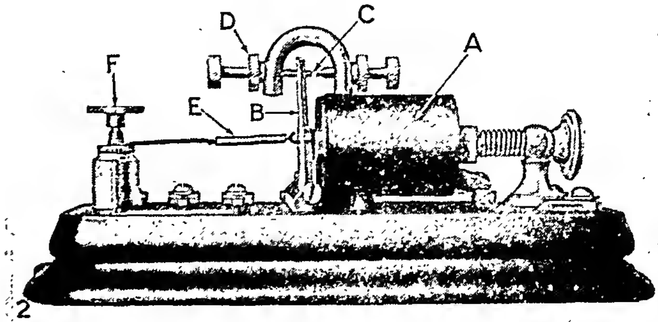
A .—	Q ——.— (..—.)	5 ..... (———)
B —...	R .—. (. ..)	6 —.... (......)
C —.—. (.. .)	S ...	7 ——... (——..)
D —..	T —	8 ———.. (—....)
E .	U ..—	9 ————. (—..—)
F ..—. (.—.)	V ...—	0 ————— (——)
G ——.	W .——	. .. . (..——..)
H	X —..— (.—..)	, .—.—.— (.—.—)
I ..	Y —.—— (.. ..)	? ..——.. (—..—.)
J .——— (—.—.)	Z ——.. (... .)	: ———... (—.— . .)
K —.—	1 .———— (.——.)	; —.—.—. (... ..)
L .—.. (——)	2 ..——— (..—..)	" " .—..—. (..—. —.)
M ——	3 ...—— (...—.)	
N —.	4 ....—	
O ——— (. .)		
P .——. (.....)		

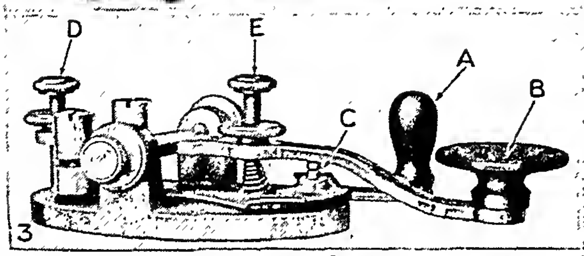
Both Morse and International codes are shown here, Morse (where different from International) being in parentheses. All land lines in the United States and Canada use Morse, while radio and the land lines of other countries use International code.

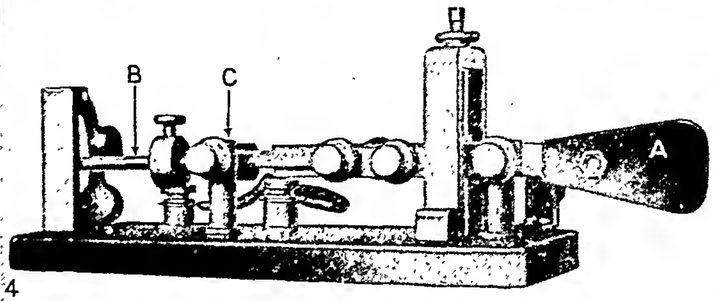
But these pioneer telegraph systems were all dwarfed to insignificance by the invention of the electric telegraph. Almost as soon as men began to investigate electricity the idea of using it for sending messages was born. Franklin and others experimented with the Leyden jars, but not until the time of Sir Charles Wheatstone and Sir William Cooke in England, and Morse in the United States, was any practical system of telegraphy devised. Morse's system was the best and led to the development of the modern telegraph system. (*See* Morse, Samuel F. B.)

Morse completed a working model of his epoch-making invention in 1835. He filed *caveat* for patent in the United States in 1837, and in 1844 the first telegraph line for commercial purposes was built between Washington and Baltimore. As in the case of most startling inventions, people were skeptical about Morse's device and heaped ridicule on the idea that messages could be actually carried over wires in such a mysterious way.

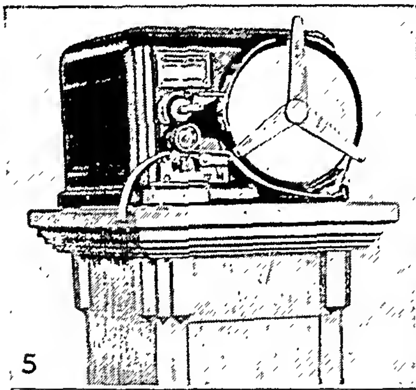


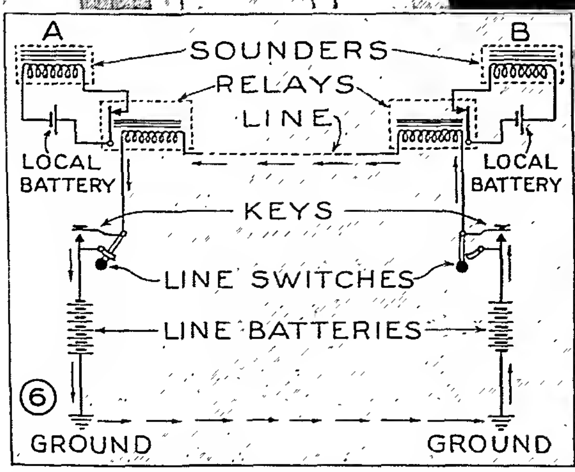


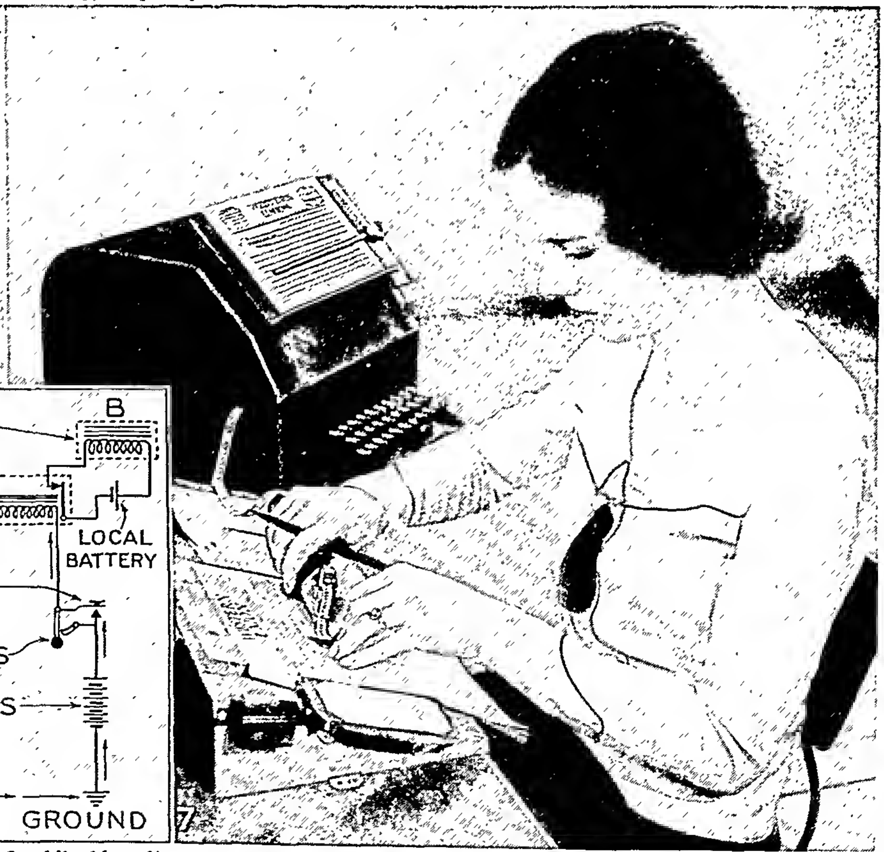




In the Morse sounder 1, current flowing through the coils A magnetizes their cores, attracting an iron armature B, thus pulling down a lever fastened to B to make a click. The stops C limit the motion, while a spring D lifts the lever when the current stops, making another click. In the relay 2, current in coils A pulls a light armature B to the right, closing a local circuit at C. An insulated stop D limits the motion, while a spring E and its tension adjustment F govern the armature. The Morse key is shown in 3. The knob A on a switch, is kept closed except when sending. Pressures on B make the dots and dashes at the contact C, and D and E are adjusting screws. The vibroplex, or "bug," is shown in 4. A pressure on A to the right makes a series of dots through the vibrator B and contact C. Pressure in the opposite way makes the dashes. These instruments are largely used to prevent "telegraphers' cramp," or paralysis of the arm and wrist.







The new "high-speed" ticker is shown at 5, while 6 is a diagram of the standard Morse circuit. B is sending to A, and the small arrows show the path of the current. At 7 we see the modern way of handling messages. The teletype machine in the background types the message on a tape, which the operator gums on a blank. When she wishes to send a message, she types it on the teletype keyboard, the machine transmitting the corresponding signals to a similar machine at the other end of the line. A typed record is preserved at the sending end also, being made by the machine on the narrow tape. Recently an "exchange service" has been inaugurated, whereby subscribers may be connected direct to each other. Messages are charged for by time used.

Operation was at first unprofitable and development was slow. But the railroads soon adopted the new device to aid in the running of trains. Today the United States is crossed in every direction by a network of wires—more than 2,000,000 miles of them—over which pass many millions of messages a year. Telegraph principles have also been extended under the sea and also through the air (*see* Cables; Radio).

A telegraph system, in its simplest form, consists of a dependable supply of electric current, a path over which the current may travel, and apparatus for sending and receiving messages. In the early systems current was supplied by battery cells, but the invention of the dynamo and the storage battery has furnished a more steady and constant current for telegraph purposes (*see* Electric Generator and Motor). Only one wire is needed to join one station with another, for the circuit is completed by "grounding" or connecting each terminal with a metal plate sunk in the ground, and the return circuit is made through the earth.

SENDING A CABLE BY TELETYPEWRITER

As the operator types a message, her machine punches holes in a tape. The tape is fed to a transmitter, and signals corresponding to the holes go out over the cable.

The sending instrument or transmitter is simply a convenient means for opening and closing the electric circuit. When the key of the transmitter is pressed down the circuit is closed, and when the key is released a spring pulls it up and breaks the circuit. As the circuit is closed and opened, the current flows and stops; and the action of electricity is so lightning-swift that the opening and closing of a telegraph key in New York is recorded in San Francisco at almost the same instant. Quickly pressing down and releasing the lever represents the "dot" in the Morse code, and holding for a slight interval represents a "dash." How the dots and dashes represent letters is shown on page 36. The Morse code is used over land lines in the United States and Canada. The International code is used over land lines of all other nations for intercontinental messages and by all ships at sea.

At the other end of the circuit is the receiving instrument, or sounder. It was in the construction of the sounder that Morse made his big contribution, for he employed the newly discovered electromagnet, which made it possible to receive messages at distances so great that the current has become quite weak (*see* Magnet). When the current reaches the sounder, it flows through coils of wire wrapped around a bar of soft iron. This bar then becomes a magnet and *attracts a metal* bar (called an *armature*) on a lever, so adjusted that it strikes with a click. The instant the current ceases to flow, the magnetic force is lost and the lever is released and pulled up by a spring. As the circuit is rapidly closed and opened by the sending of the dots and the dashes from the key, the lever snaps down and up against metal stops, and clicks off the sounds which you hear in a telegraph office.

Morse's first receiver had a pen attached to the lever, which marked a strip of paper moved along regularly by clockwork. But it was found that messages could be read by simply listening to the clicking of the instrument, and the pen was discarded. In former days, the receiving operator wrote the message down, but now "telegraph printers" or "teletypewriters" are used.

The sending operator working a telegraphic printer uses a keyboard much like that of a typewriter, a paper tape being perforated with a combination of small holes, usually five, one such combination for each character. These holes pass under contact fingers, which send a corresponding combination of current pulses over the line. At the receiving end, the various combinations of current pulses cause an electrically operated typing machine to write the various letters either on a narrow tape, which is then pasted down on a telegraph form, or to print the message on a letter-size sheet of paper.

In sending a message more than a few miles, the electrical resistance of the wire becomes so great that the current is too feeble to operate the usual sounder. This trouble is overcome by *relays*. A relay is much the same in principle as a sounder, but its coils are wound with a great many more turns of wire, so that the relay is sensitive to feeble currents. The contacts on the armature make and break a local circuit, so that a strong current duplicating the feeble dots and dashes received, goes forth to carry the message along the next stretch of main line. A sounder in the local circuit will follow the signals in the main line.

Since telegraph lines are expensive to build and maintain, it is desirable to increase the carrying capacity of the wire as much as possible. One way of doing this is to speed up the transmission of the messages. A fast hand operator may send as many as 50 words a minute for a short time, but the automatic printers described are able to send from 80 to 350 words a

minute. Edison reached the practical limit of transmission with a single current when he successfully dispatched 3,100 words a minute with a chemically treated tape.

More service can be obtained from a wire, however, by using electrical or mechanical methods of sending several messages at once. Edison invented three such systems. He used magnets sensitive to current passing in one direction but not another, and other similar devices. With his *duplex* system, one message could be sent each way at the same time on one wire. His *quadruplex* system doubled this capacity, and the *sextuplex* method tripled it.

Modern *multiplex* telegraphy depends upon a mechanical device which consists essentially of a pointer traveling at high speed over a metal circle. The circle is divided into eight insulated segments, and a transmitter is connected to each segment. As the pointer whirls, it catches the successive parts of each message in turn from the segments. At the receiving end, a pointer whirls at exactly the same speed and distributes the parts of the messages to their proper segments on a receiving circle. From there the "unscrambled" messages go to printers which type them.

Additional messages can be loaded on the multiplex wires by using tuned carrier currents, somewhat like the carrier waves of radio. This method is particularly valuable when some news event swamps a small telegraph office with messages. The emergency is met by installing portable apparatus to handle the extra business by the carrier-current method. With a combination of all methods, four wires can be made to carry 120 messages at once.

Various special services are offered by telegraph companies. They lease wires at special rates to customers wishing to send their own messages. Pictures of handwriting, designs, and so on, called *facsimile messages*, are sent between some stations by telephotography (*see* Telephotography; Television).

Telegraph companies are classed as public utilities, and are subject to regulation by the Federal Communications Commission, established in 1934.

The telegraph-wire mileage in leading countries is given with the entry **Telegraph** in the FACT-INDEX.

The MAGIC *of* TELEPHONE *Communication*

TELEPHONE. More than 170 million times a day somebody in the United States telephones somebody else. This enormous number of calls shows how important telephones are in modern communication. All the letters, post cards, and telegrams Americans send every day do not amount to half the number of telephone calls they make.

The word *telephone* is from Greek terms meaning "at a distance" and "voice." Telephones carry the sounds of the human voice over great distances by either wire or radio. They reproduce the tone and inflection of a person's voice perfectly. One person can speak to another on the telephone as though they both were in the same room. This is one of the many aspects of the telephone which make it so important in modern communication.

The Telephone Has Changed People's Lives

Since the telephone was developed in the 1870's and 1880's, it has made many changes in our ways of living and doing business. It has made close neighbors of people living miles apart in lonelier parts of the country. It has helped to make possible huge office buildings and stores. People can talk instantly with each other in any part of a building, instead of having to go from one place to another. In the same way the telephone links together every part of a great city. Telephone lines are among the most important links between cities also. Today businessmen can arrange important matters instantly, even though they are thousands of miles apart at the time they talk.

In some ways the telephone has been of greater service to farmers than to any other group of people. In the United States and Canada farmhouses tend to be far apart. But farm families can be neighbors by using the telephone. A farmer can get up-to-the-minute market information by telephone. He can reach feed and supply stores, his doctor, veterinarian, and others without loss of time.

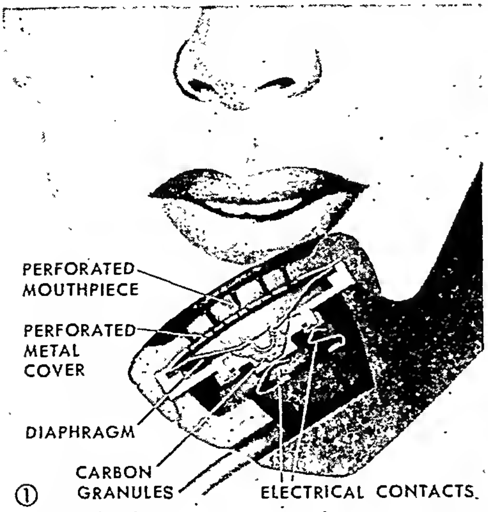
Before telephones became common, farming was a lonesome occupation in many parts of the country. Where roads were bad in winter, farm families knew little of what was going on among their neighbors. Now more than half the farms in the United States are served by telephones. Much of the winter isolation and boredom of farm life in the North has been ended.

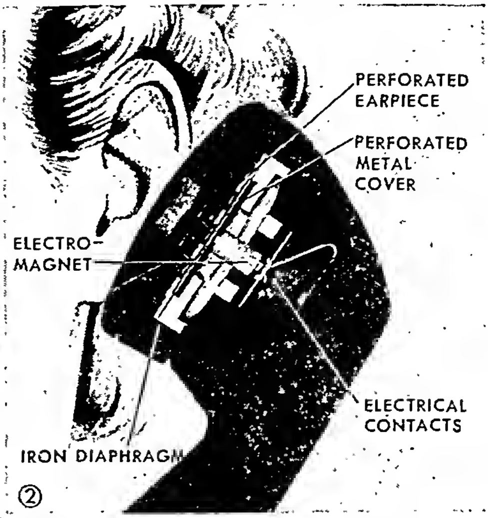
The telephone means a great deal in the life of every family in the city also. In emergencies firemen, policemen, or doctors can be called quickly and many lives are saved by using the telephone. In most communities housewives can use the telephone in ordering from department stores, grocery stores, and other establishments, saving themselves a trip. In purely social affairs, also, the telephone has become extremely important. Nowadays people send written invitations only for the most formal events. For most parties and other social affairs we simply telephone our friends and ask them to come.

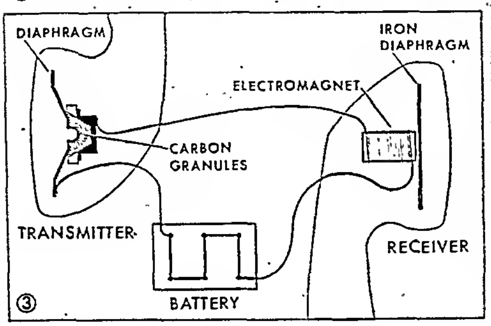
The telephone also performs many services of which we are not always aware. Television programs are carried long distances by coaxial cables—large, specially constructed telephone cables and by radio-relay systems (*see* Television). Radio programs are carried by ordinary telephone lines to most of the stations in a network (*see* Radio).

Modern news reporting is speeded up in many ways by the telephone. It helps reporters and editors in gathering news quickly. Stories are typed out on scores of teletypewriting machines. These send the stories from city to city over telephone wires leased to the big news-service organizations (*see* Newspapers; Telegraph). Photographs, maps, and other illustrative material are rushed to newspapers over

CARRYING THE HUMAN VOICE BY WIRE







1. The heart of a telephone transmitter is a carbon microphone behind the mouthpiece. The diaphragm is conical, and a thimblelike projection extends into the bowl of carbon granules. The transmitter works equally well in any position.

2. The receiver converts electric current back into sound. The most modern type, shown here, is a small removable unit. In older types the diaphragm is a separate part.

3. The article explains more fully how the telephone transmitter and receiver work. This diagram shows in simplified form how a fluctuating current carries sound from the transmitter of one telephone to the receiver of another. Batteries which supply current to most real telephone systems are kept constantly charged by electric generators.

telephoto senders and receivers. These too are linked by telephone lines (*see* Telephotography).

How a Telephone Instrument Works

All these varied services mean that the telephone system of the United States is highly complex. This is true, but the essential *principle* of any telephone system is relatively simple. A telephone system consists of a number of telephone instruments connected by thin copper wires to switching equipment which can link together any two telephones. Every telephone system also has a battery or other source of electric current to supply power.

The most important element of a system is the transmitting and receiving instrument, the part ordinarily called a "telephone." The transmitting part of this instrument turns sound into a fluctuating electric current, and the receiving part turns such a current back into sound.

The telephone can be made to work, first of all, because sound travels through the air in waves. These are something like the ripples on the surface of a pond when a pebble is dropped into the water (*see* Sound). Human speech is carried by waves in the air stirred up by the vibrating vocal cords in the throat.

These sound waves exert power enough to bend a thin sheet of metal slightly. Such a metal *diaphragm*, as it is called, springs back to its original position after each wave passes it. Thus the diaphragm will vibrate in the exact pattern of the voice waves which strike it.

A telephone transmitter consists, essentially, of a small metal diaphragm covering a little box of carbon granules (powdered coal). An electric current passes constantly through the diaphragm and powdered coal. When the granules are packed closely together they allow more of the electric current to get through than they do when they lie loosely separated. Now when a voice wave pushes the diaphragm of a telephone transmitter inward, the diaphragm then pushes the granules closer together and a great deal of current surges through. When the diaphragm springs back the current returns to normal. In this way the electric current varies in strength exactly in step with the voice waves. Consequently the variations in current amount to an electrical "pattern" of the speaker's voice.

This fluctuating electric current travels over wires to a telephone receiver. The telephone receiver is nothing more than an electromagnet, something like the electromagnet that pulls the clapper of an electric doorbell back and forth. An iron diaphragm is placed close to the electromagnet in the telephone receiver. When a surge of current flows through the coil of the magnet, the magnet pulls the diaphragm inward. As the current weakens, the magnet pulls less strongly and the diaphragm springs back. Thus the diaphragm is set to vibrating exactly as did the one in the distant transmitter. The vibrating diaphragm sends forth sound waves, and the listener hears these waves as human speech, just as if the caller were speaking to him directly.

Handling Calls in a Small Office

Before one person can talk to another over a telephone, their telephone instruments must be linked together. There are two general ways by which this is done. A telephone operator may make the connection by hand, or machinery may do it automatically. A telephone system using operators for all calls is called a *manual* system. One using automatic equipment is a *dial* system. Whichever method is used, any call must go through a *central office* so the proper connections may be made.

In small cities and rural communities, one central office may serve all the telephones in the area. A big city, however, has scores of central offices (often called *exchanges*). Every subscriber's telephone is connected to a particular central office and "belongs to" that office. The particular telephone is identified by the office name and a number. In a small town called, say, Woodville, a particular subscriber's line might be identified as Woodville 211.

In such a town the telephone office may be run by a single operator. She sits at a switchboard to which every telephone in town is connected. When a subscriber wants to call another number, he simply picks up his telephone and waits for the operator to answer. By lifting the telephone instrument, or *handset*, he closes a circuit in the line and a tiny light on the operator's switchboard starts to glow. Upon seeing this signal, the operator connects her own telephone to the subscriber's line. (She wears a *headset* that leaves her hands free.) She does this by pushing a metal *plug* on the end of a cord into a hole, called a *jack*, under the signal light. Then she says "Number please?" to the subscriber.

He tells her the number he wants and she finds the jack on her switchboard corresponding to that number. Then she pushes a plug into that jack. This plug is connected to the other end of the cord she used in answering the subscriber's signal. Thus a complete circuit is established between the two telephones.

The operator then pushes a button on her switchboard which sends a current into the called telephone to ring its bell. As soon as the called party answers, the operator leaves the line to handle other calls. When the connected parties stop talking and hang up, a second switchboard light comes on, signaling the operator to take down the linking cords.

Switching in a Big Manual Office

Any manual office handles a call in just about this way. In a big city, however, a call goes through at least two switchboards. Any office with more than 6,000 subscribers almost always has two boards. One, called the "A" board, handles calls *from* subscribers. The other, called the "B" board, takes care of calls *to* subscribers.

When a subscriber lifts his handset, the "A" operator answers. He gives her the number he wants: for example, "Main 4240." She says "Thank you" and plugs into a trunk line to the "B" board in the Main office. She has connections to several trunks and before plugging in she tests to find a free one. She does this by running the plug down a row of jacks until she gets a signal (a short "dit dit") that indicates the trunk line is free. She then says to the "B" operator in the Main office "4240" and the "B" operator makes the connection.

When a subscriber calls another number in his own exchange, the call still goes through two boards. The "A" operator relays the call to the "B" operator in her own office and the "B" operator makes the connection. They may be sitting only a few feet apart.

How a Dial System Works

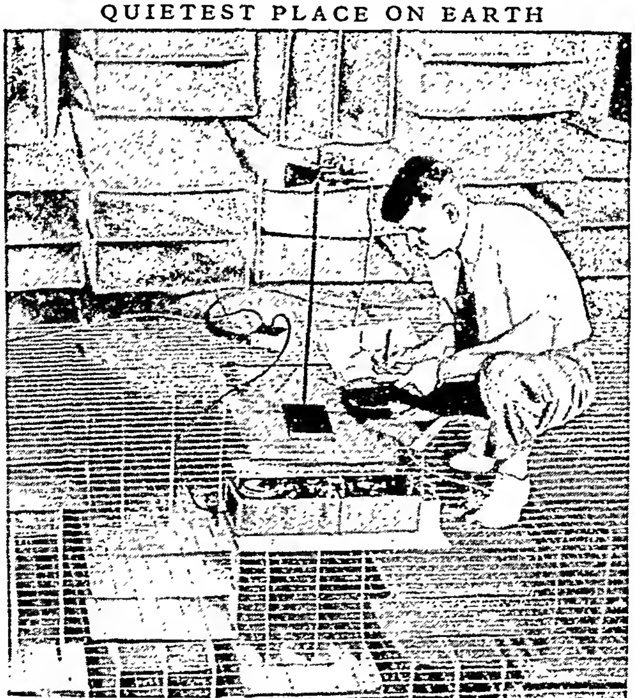
A dial telephone system imitates the steps outlined above almost exactly. Dial systems are now much more widely used than manual systems. About three quarters of all the telephones in the United States are dial operated.

Dial equipment goes into action the moment a subscriber picks up the telephone handset. An electrical signal flashes from the telephone to automatic switching equipment in the central office. This signal corresponds to the switch-

CONNECTING MORE FARMS BY TELEPHONE

This lineman high up on a pole is one of the many workers who make possible modern telephone service. He is splicing connections into a main circuit to make ready for new rural lines.

QUIETEST PLACE ON EARTH



In the world-famous Bell Laboratories at Murray Hill, N. J., this "dead room" is completely lined with sound-absorbing Fiberglas. The tennis-racket floor can support experimental equipment weighing many tons.

board light in a manual office; it indicates that a connection is to be made. The dial apparatus responds by hunting for the line from which the call is coming. When the mechanism reaches this line, it sends out a steady humming signal called the *dial tone.* This humming has the same meaning as the "A" operator's "number please." It shows that the equipment is ready to handle the call.

OPERATOR AT A "B" BOARD

The busy switchboard operator still handles a great deal of telephone traffic. This young woman is an operator at the "B" board of a big-city central office that still uses the manual system.

Usually the first outgoing signal and the answering dial tone go through before a person has time to get the handset up to his ear. But occasionally, especially during an emergency such as a severe storm, a great many people want to use the telephone system at the same time. The dial equipment can handle only so many calls at the same time. In these cases it may be a few seconds before a unit of dial equipment is free from one call to handle another. The dial tone may then be delayed slightly. Until the dial tone announces that a switching unit is on the line, the subscriber cannot make his call.

Once the dial tone is on the line, the subscriber can "dial" his call. To do this he puts his finger in the hole of the dial wheel over the first letter or digit of the number he is calling. He pulls the wheel around clockwise until his finger is against a metal hook; then he removes his finger so the wheel can return to its original position. He repeats this process for every digit in the number.

Telephone numbers in most dial systems consist of two letters and a single digit identifying the office, followed by four digits identifying the particular line. Thus an office named Washington 7 would be identified by the symbol WA 7. One particular line in this office then might be 6432. So the complete telephone number would be WA 7-6432. These are the letters and numbers a caller would dial to get this line.

While the number is being dialed, automatic switching equipment in the central office counts the number of clicks made by the dial wheel as it returns to position. Each click is a momentary interruption of the current. One click, for example, means that the digit 1 was dialed. Seven clicks mean that the caller dialed the digit 7 (or the letter P, R, or S). A particular pattern of clicks thus identifies a particular telephone just as readily as though the caller had given the number aloud to an operator.

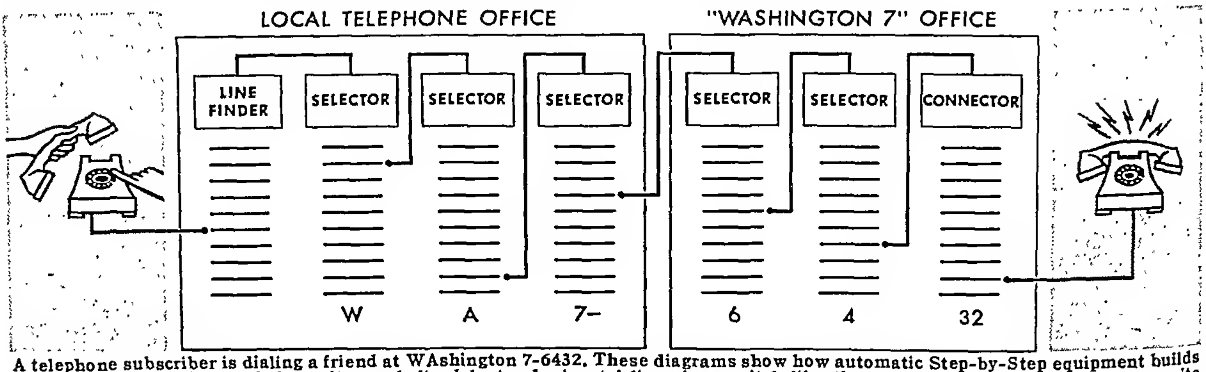
Automatic switching equipment in the central office uses the information it gets from these clicks to find the telephone line the caller wants. Once it locates the right line, it sends out an electrical impulse which rings the bell in the telephone being called just as an operator would do. It continues to ring the bell until someone answers or until the caller hangs up. If the telephone being called is already in use, the dial apparatus reports this information to the caller by sending back to the caller a rapid "buzz-buzz-buzz" signal. This signal means "the line is busy."

Once the complete connection is made and the called party has answered, the dial equipment retires from the line, ready to handle another call. The connection remains until one party or the other hangs up.

Different Dial Systems

There are three different methods of automatic switching in common use in the United States. Even though these three kinds of equipment differ considerably from each other, signals from any dial telephone instrument will cause them to operate. All of them use the same pattern of clicks to put through a call. The three systems are known as Step-by-Step, Panel, and Crossbar.

HOW AUTOMATIC EQUIPMENT BUILDS UP A CONNECTION STEP BY STEP

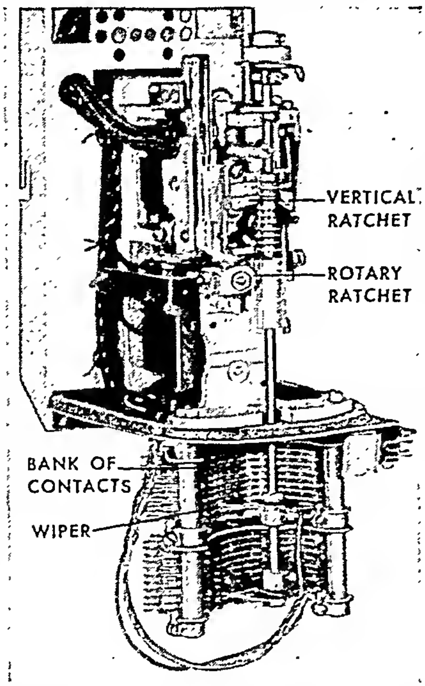


A telephone subscriber is dialing a friend at WAshington 7-6432. These diagrams show how automatic Step-by-Step equipment builds up the connection. Each of the units symbolized by ten horizontal lines is a switch like the one shown at the top of the opposite page. The article explains the operation of this system.

The Step-by-Step system is the oldest and simplest to understand. The first commercial installation was made in 1893. The heart of this system is the switch shown on this page. Its principal working part is a vertical rod with one or more horizontal wiper arms fixed to it. This assembly can move up, a step at a time, through 10 positions. It can also rotate through 10 positions. Thus each wiper can touch any of 100 electrical contacts.

A series of these switches go into action one at a time to build up a connection step by step. The first switch, called a *line finder*, connects switching equipment to the subscriber's line as soon as he picks up his telephone. It also sends the dial tone into the line. Then as the caller dials, clicks from a motion of the dial wheel actuate a *selector switch*. For example, nine clicks (standing for the letters, W, X, Y, or the digit 9) send the rod up nine levels. There it pauses and moves round until it finds an idle line to the next switch. The first three selectors build up a connection with the called office. Then as the subscriber dials the four digits of the number, similar switches in the called office go into action. The last two digits operate only one switch, the *connector*. The next-to-last digit moves the rod vertically to the proper level; and the final digit moves it around horizontally to the desired line. Ringing current is then sent into the called telephone.

STEP-BY-STEP SWITCH



Impulses from the dial cause electromagnets to move the vertical rod of this switch up and around. Connections are made through the wipers at the base.

Step-by-Step equipment is used in communities of all sizes, but particularly in small cities. In big cities Panel or Crossbar systems are generally used because they can handle more calls at the same time. Both these systems use the principle of "memory." As the caller dials, a *sender unit* stores up the information it receives and then sends it on as a unit. One sender "remembers" the first three signals (identifying the exchange wanted); then in one action it connects the subscriber's line to a trunk line. Another sender does the same for the rest of the number. In this way switching equipment is tied up only a fraction of the time it would be if the connection were built up step by step as in the older system.

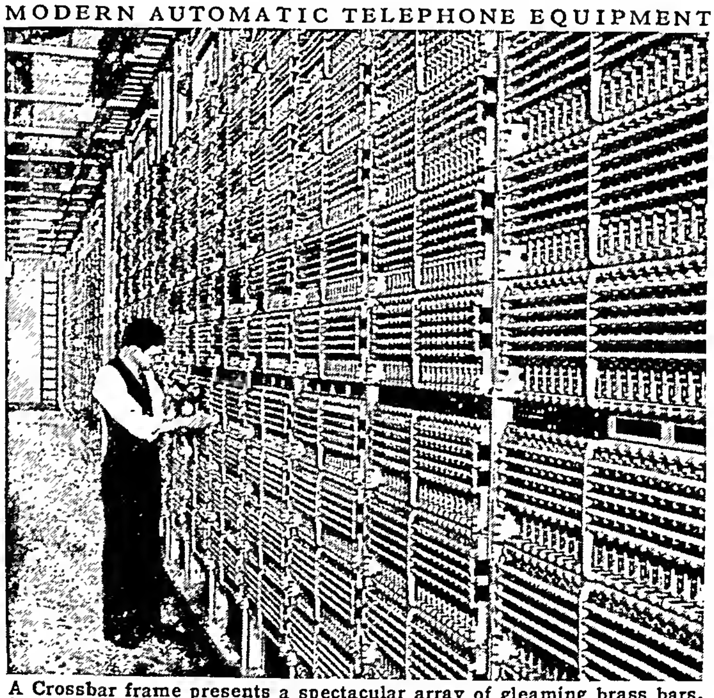
The switching equipment differs in the two systems. A Panel switch is a vertical brass tube with wipers somewhat like those of a Step-by-Step switch. It is moved up and down by a cork roller at its foot. Crossbar equipment moves only slightly in switching. A connection is made between crossed bars a few thousandths of an inch apart. These bars serve as electrical terminals. One set of bars is vertical and parallel, like the pickets of a fence. The other (horizontal) set is placed close to the vertical bars and in front of them. Any vertical bar can form a connection with any horizontal bar if both move just slightly toward each other. Thus Crossbar equipment is extremely fast in its operation. Panel equipment was developed during the first World War. The first Crossbar installation was made in 1943. For new installations in big cities Crossbar equipment is usually used.

Central Offices and "Outside Plant"

In addition to serving as a switching center, a central office performs other services as well. In a big city a telephone office has switchboards and operators for handling long-distance connections only. An information operator is always ready to give subscribers information about telephones not yet listed in the directory. She has a specially printed directory that is kept up to date from day to day. Still another operator in the central office gives help to callers who have difficulty getting a call through.

Many central offices also house the telephone company business office. Here accounts are kept and subscribers are billed for the amount of telephone service they use during the month. The engineering

MODERN AUTOMATIC TELEPHONE EQUIPMENT



A Crossbar frame presents a spectacular array of gleaming brass bars. Through these vertical and horizontal members, connections are made with the least possible movement of parts.

department of a central office has elaborate equipment for testing lines and switches. Current-generating equipment is usually located at the central office also. Talking current comes from huge batteries kept charged by direct-current generators. These are driven by motors powered by regular city current. In emergencies, a telephone system can operate for a time on reserve current in the batteries. Generators can usually be driven by Diesel engines also.

Central offices are linked with subscribers' telephones by an extensive network of wires called *outside plant.* The plant consists of single wires such as the *drops* from a house to the nearest telephone pole; underground and aerial cable; and poles and other material that supports or protects the wire network. A cable is composed of many individual copper wires insulated with paper; the entire bundle of wires is enclosed in a sheath of lead or tough plastic. The largest cable in use today is about as big around as a baseball bat. It has more than 4,000 individual wires. Installing and tying together cables is done by specially trained cable splicers who do nothing else.

TELEPHONING WHILE "UNDERWAY"

Mobile radiotelephone was introduced just after the second World War. With it installed in a delivery truck or private automobile, the driver of the vehicle can call any telephone through the local central office.

How the Telephone Came into Being

The huge telephone network of the United States provides work for nearly three quarters of a million persons. Their pay roll amounts to more than 2 billion dollars a year. About four fifths of the telephones in the United States are operated by the Bell System. This comprises the American Telephone and Telegraph Company—the parent company—and some 20 subsidiary telephone companies. Part of the Bell System are the Western Electric Company, manufacturers of telephone equipment, and Bell Laboratories, a great research organization.

When the first telephone was made, about a decade after the American Civil War, no one could have dreamed that such a vast system could develop from the squeaky little instrument. The inventor of the first practical telephone was Alexander Graham Bell. He probably conceived the idea of telephony in 1874 but saw no way to make it work at that time. The following year he was working with his assistant, Thomas A. Watson, on a "harmonic telegraph" which should carry several telegraph messages at once. While experimenting with this device, he accidentally discovered a way to transmit a musical tone over an electric wire. The device might have remained a mere curiosity if Bell had not been thinking about the possibility of transmitting human speech by electricity. Within a short time, however, he designed and Watson built the first electric telephone to carry intelligible speech. *(See also* Bell, Alexander G.)

The telephone was thus the result of scientific research, and Bell himself insured that research and improvement should continue. He and his backers gave Watson a tenth interest in the first telephone company on the condition that he devote his full time to the improvement of telephony.

Improving Telephone Service

In early days, a great deal of work had to be done to perfect the basic equipment. For example, a two-wire copper circuit was developed to replace the original circuit of iron wire and ground. Cable was developed to replace cumbersome open wires on poles. Means were invented to prevent the weakening of voice currents over long distances. The transmitting and receiving instrument was constantly improved by scientists and telephone engineers. Long-distance telephone lines linked New York City with Chicago in 1892 and with the Pacific coast in 1915.

After the invention of the audion vacuum tube in 1906 it became possible to transmit speech by means of radio waves as well as wires (*see* Radio). Thus the science of *radiotelephony* was born. This applies to all types of standard broadcast radio as well as private radiotelephone service across the oceans and to ships at sea. The first radio network was formed in 1923 when four stations were linked by long-distance telephone lines for a special broadcast. Electronics did much to improve land lines also. Special equipment used on long-distance cables enables two pairs of wire to carry up to 12 conversations at the same time. This apparatus is electronic in nature.

Capacity of the long-distance telephone network has been greatly expanded by use of coaxial cable

SOME HINTS ON USING THE TELEPHONE

Be sure of the number you are calling before picking up the telephone.

Speak directly into the transmitter. Your lips should be about half an inch from the mouthpiece. Use a normal tone of voice; loud talk distorts and blurs the voice over the telephone.

Allow ample time for your party to answer. Fifteen rings is not too long to wait.

In signaling the operator, move the receiver hook slowly three or four times. If you jiggle it too rapidly the operator cannot see the signal.

Answer the telephone promptly. In answering, it is a good idea to give your telephone number rather than simply saying "Hello." This saves time and often embarrassment.

and microwave radio relay. These facilities are used by the Bell System, which owns them, and by the television networks. Coaxial cable contains as many as eight copper tubes with copper wires running through them. Plastic washers about an inch apart keep the wire in the exact center of the tube so that both have a common axis—hence the name coaxial. One coaxial tube can carry hundreds of telephone conversations simultaneously or one television program.

The microwave radio-relay system consists of directional antennas on high towers. A very high-frequency radio signal is beamed from one to the next, skipping across the country in short leaps. Radio relay, like coaxial cable, can transmit the complicated television frequencies and a large number of telephone messages. The United States is linked from coast to coast by these two systems. (*See also* Television; Radio.)

THE TELEPHONE WORKS

"Mr. Bell, I heard every word you said—distinctly!" While testing an experimental telephone, Bell had spilled acid on his clothes and called to his assistant, "Mr. Watson, come here; I want you." Watson, in another room, heard Bell's voice over the telephone. This was the first message carried by a telephone.

Long-distance service has also been improved by "operator-toll-dialing" equipment. With this apparatus a call is dialed by an operator directly through to the distant telephone in a very brief time. In some cities telephone subscribers can dial their calls to nearby cities without the aid of an operator.

Another modern service in many cities is the mobile telephone. Using short-range radio, this service connects automobiles, trucks, trains, or harbor ships with a local telephone office.

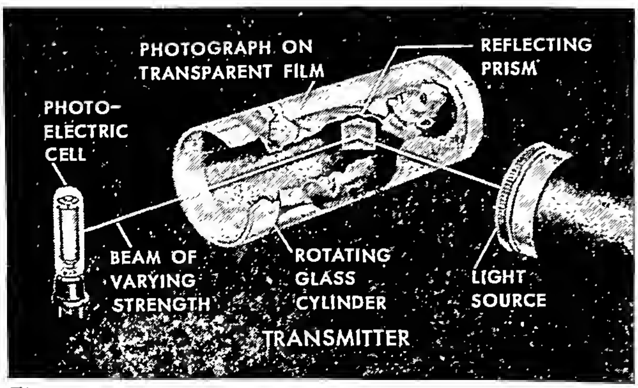
Growth of the telephone system throughout the world has been prodigious. Of all the telephones in the world, the United States possesses well over half. Second is the United Kingdom and third is Canada. The United States also has the highest proportion of telephones to population. Washington, D. C., has a greater number of telephones per capita than any other city with more than 50,000 people—more than 60 for every 100 persons. (For further telephone statistics, *see* Telephone in the Fact-Index.)

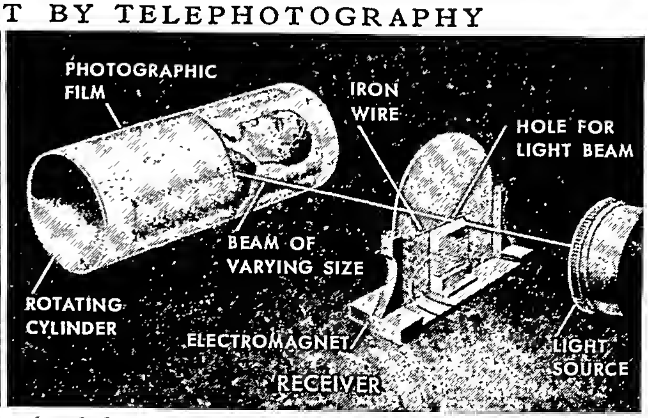
TELEPHOTOGRAPHY. "Wirephotos" and "radio photos" are common today in all metropolitan newspapers. By means of telephotography, pictures may be taken in some distant place, sent out by telephone or radio, and reproduced in a central news office within an hour. Pictures of disastrous fires often appear in newspapers thousands of miles away while the fire is still raging. The wonderful process which makes this possible is described in the pictures at the bottom of this page.

Telephotography was developed early in the 20th century by Arthur Korn, a German university professor. Previous inventions had made it possible to transmit simple images such as handwriting or line drawings by telegraph, but none of these devices permitted reproduction of photographs. Korn transmitted the first wirephoto in 1904.

By 1925 American and British developments had brought about widespread use of photographs transmitted over telephone wires. In the following year pictures were sent across the Atlantic Ocean by radio. Today color pictures can also be transmitted by telephotography. For these the scanning mechanism produces three negatives of the picture in each of three primary colors (*see* Color). At the receiving station, these are combined and printed in color.

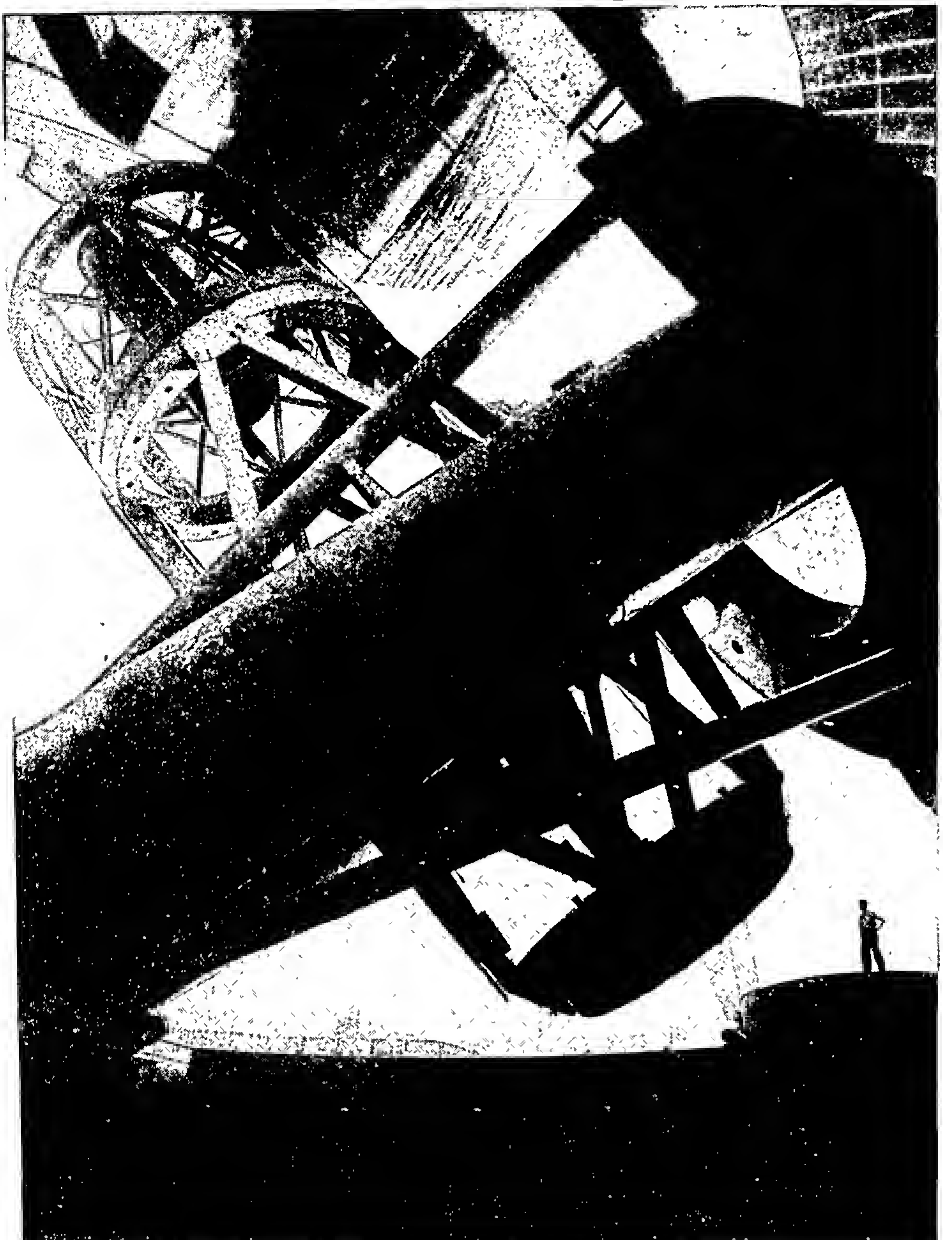
HOW PICTURES ARE SENT BY TELEPHOTOGRAPHY





These pictures show the working principles of telephotography in simplified form. In the transmitter (left) a transparent print revolves on a glass cylinder and varies the strength of a light beam striking a photoelectric cell. The cell emits a varying current, which is sent to the receiver. In the receiver (right) a wire placed above an electromagnet blocks the passage of light when the wire is at rest. The varying current from the transmitter energizes the magnet and draws the wire downward. This allows more or less light to strike a rotating film and thus builds up an exact copy of the picture.

How the TELESCOPE *Brings the* STARS *Down to* MAN



Like a huge mountain, the Mount Palomar reflecting telescope overshadows its human creator. Yet it rolls at a man's command, turning as effortlessly as the earth itself, to peer more than a billion light years into outer space. With it astronomers will discover universes never seen before.

TELESCOPE. On a Venetian housetop in the summer of 1609, a new era in the history of astronomy began. When Galileo turned his newly invented telescope to the night sky, he was struck dumb with awe at the wonderful things he saw. He found that the surface of the moon was broken by huge mountains and deep valleys. The Milky Way was not a cloudy path but a great swarm of millions of faint stars. And when he looked at Jupiter, he saw a miniature solar system with satellites revolving around the planet.

Galileo did not make the first telescope. The instrument was probably invented in 1608 by Jan Lippershey, a maker of eyeglasses in Holland. It is often said that he was examining two spectacle lenses and happened to bring them in line with a distant church steeple at the proper spacing to give magnification. Probably the truth will never be known, because several opticians applied for patents at about the same time. But it is known that about a year later, various lens grinders of northern Europe were making telescopes.

In Italy Galileo heard of the invention. Though he had never seen the instrument and had no description of it, he figured from his knowledge of lenses how it should be made. His first telescope made objects appear three times as large as the naked eye saw them. After further experimenting, he produced his best telescope, which magnified 32 diameters. The picture on the opposite page shows this instrument.

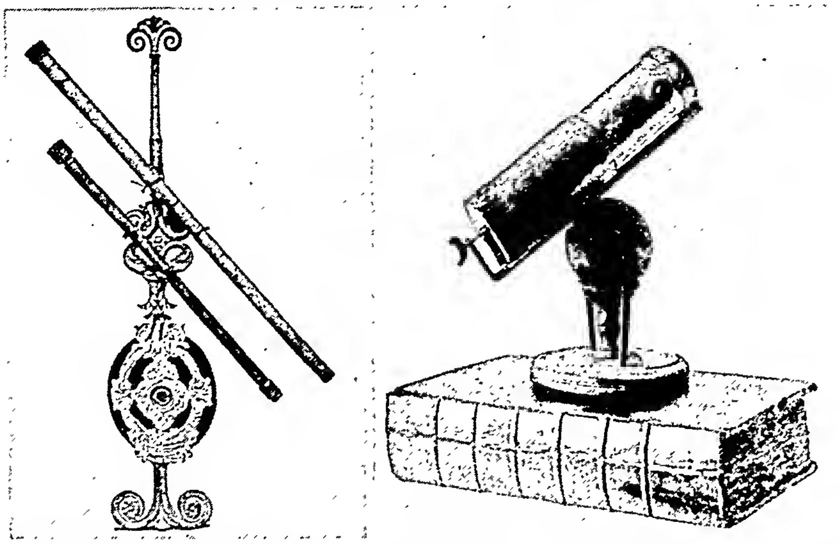
The Galilean telescope is simple in form. It consists of two lenses. The front lens (called the *objective*) is double convex—bulged out on both sides. And the back lens (*ocular*) is double concave—dished in on both sides. This telescope has the advantage of giving an *erect* (right-side-up) image with only two lenses. Its greatest disadvantage is the small area, or *field*, that it can cover. It is still used for some purposes.

Johann Kepler invented the first real astronomical telescope. It had a double convex objective and an ocular of the same type. With certain improvements, Kepler's type of telescope is still used for much astronomical work.

Early Problems in Telescope Making

As bigger and bigger telescopes were made, their users began to notice defects called *aberrations* in the images they gave. The most troublesome were blurri-

THREE HISTORIC TELESCOPES



The telescopes in the left-hand picture are Galileo's original instruments. With the larger one, 49 inches long and of 32 power, he first saw the satellites of Jupiter and made many other discoveries. Newton's little telescope on the right, resting on a copy of his 'Principia', was the first reflecting telescope ever made.

ness and rings of color around light parts of the image. These defects arise from *spherical* and *chromatic aberrations,* as explained in the article on Lens.

Early telescope makers discovered that they could cut down aberrations by making the instrument very long in proportion to the size of its objective. One famous telescope of this period was 150 feet long and had a lens only eight inches in diameter.

In 1672 Sir Isaac Newton mapped out an entirely new path for telescope makers. He believed, mistakenly, that chromatic aberration could not be overcome in a *refracting* instrument (one using a lens to gather and focus light). So he suggested using a curved metal mirror instead of a lens. The small model he made of his *reflecting* telescope is shown on this page. Light fell on the principal mirror (*speculum*) at the back of the tube. From there it was reflected forward to a small flat mirror set at a 45-degree angle near the front of the tube and from here it was reflected out the side of the tube through an eyepiece. Newton's solution of the problem was brilliant, but at that time no one could grind the sort of speculum required for a powerful astronomical telescope.

Fifty years later, John Hadley succeeded in doing this. His telescope was a great success. It performed better than all but the very largest refracting instruments, and in addition was small and compact. For the next 35 years, nearly all the astronomical telescopes built were reflectors.

In 1758, however, the London optician John Dollond patented a refractor which was *achromatic* (free from chromatic aberration). It solved the problem Newton thought could not be solved. He was not the first to make such a telescope. Chester Moor Hall had made achromatic instruments 25 years earlier. But few people realized the value of his invention because he did not put it before the public.

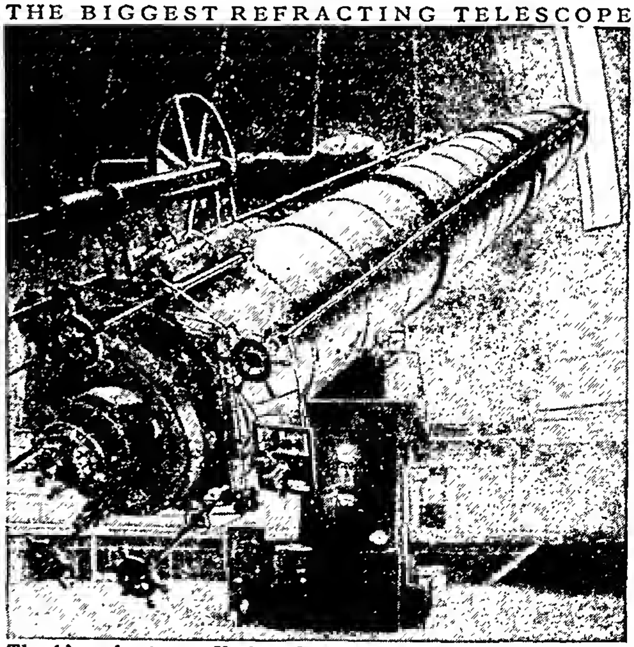
Both men solved the problem by making the objective lens in two parts, one of *crown* glass and the other of *flint* glass. Each type of glass had chromatic aberration, but they were arranged so that the aberrations canceled each other. This type of telescope performed so well that it again established the refractor as the more popular type. During this period, however, Sir William Herschel, the famous organist-astronomer of Bath, made many superb telescopes of the reflecting type. Several were extremely large instruments.

Nineteenth-Century Developments

Both the refracting and the reflecting telescopes were improved during the 19th century. Early in the century, Pierre Guinand, a Swiss glass maker, learned how to make optical glass of high quality. Later Joseph von Fraunhofer, the great German physicist, used this glass for his scientifically designed lenses. He also perfected the clock-driven *equatorial* mounting for the telescope. This device enables a telescope to follow a star automatically as it moves across the heavens, since it turns exactly contrary to the rotation of the earth (*see* Astronomy).

About the middle of the century, Karl Steinheil and Jean Foucault independently began using a process for depositing silver on glass to form a mirror. This process had been invented by Justus von Liebig. It made the reflecting telescope enormously more useful and popular. Before this time, telescope mirrors had been made of a metal extremely difficult to work. They tarnished quickly, and repolishing them often meant weeks of refiguring. But glass was fairly easy to

THE BIGGEST REFRACTING TELESCOPE



The big refractor at Yerkes Observatory has a lens 40 inches in diameter. It will probably remain the largest instrument of its kind; lenses bigger than 40 inches are so distorted by their own weight that they cannot be used in telescopes.

work, and the thin silver coating on the top surface of the glass could be renewed without any refiguring.

Work in the 20th Century

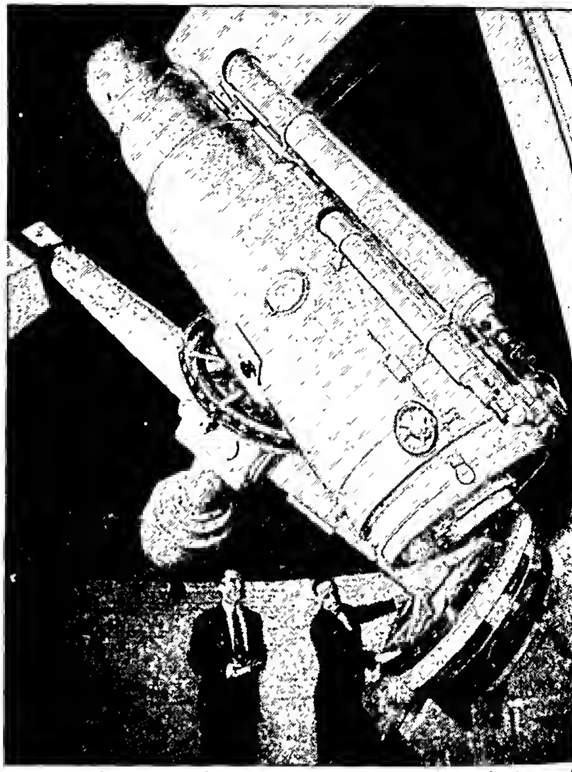
The 20th century has been the era of big reflecting telescopes. The biggest in the world is the huge California Institute of Technology instrument on Mount Palomar near San Diego. It has a mirror 200 inches ($16\frac{2}{3}$ feet) in diameter and can penetrate into the blackness of space two times as far as its closest rival, the 100-inch Mount Wilson telescope. The 200-inch telescope is one of the great achievements of our age. It was first planned in 1928 and was put in operation in 1948, exactly 20 years later. As in most modern reflectors, the "tube" is an open steel framework which supports the mirrors.

In the 1930's a new process for surfacing telescope mirrors was developed. A film of aluminum, rather than silver, is deposited on the face of the glass. This metal tarnishes much more slowly and reflects more light than silver. Now mirrors have to be resurfaced only every two to five years, instead of every six months as they formerly were.

The 20th century has also seen the development of the Schmidt type of telescope. It is an entirely new kind of instrument which uses both reflecting and refracting surfaces. It is used mainly for photographic work and is often called the Schmidt camera.

Astronomers today use many types of telescopes. No one kind serves all purposes. They use both refractors and reflectors, as well as many special types, such as the Schmidt. America has led the world for more than 50 years in the production of large telescopes.

AN ASTRONOMICAL CAMERA



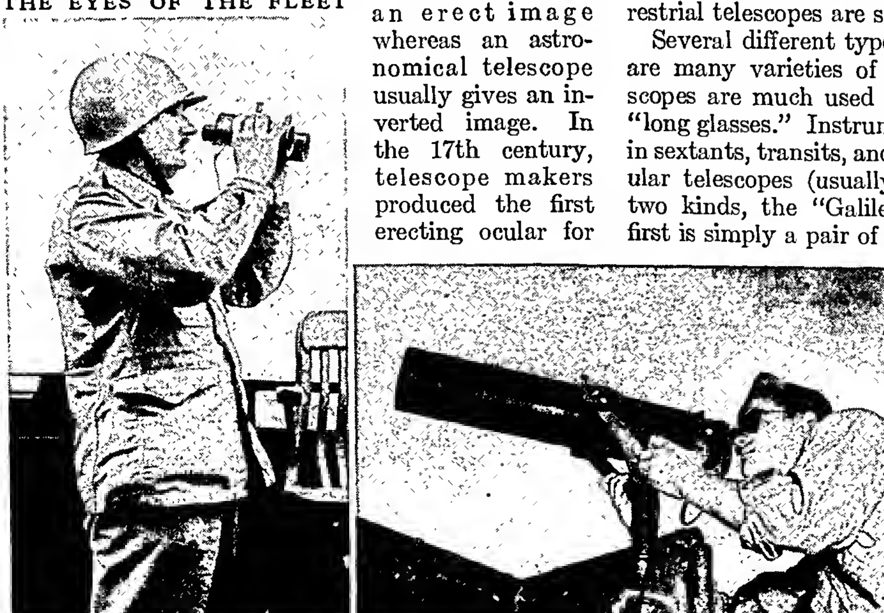
The Schmidt camera is a refracting and a reflecting instrument. Light passes through a *correcting plate* (a very slightly curved lens) at the front of the tube and strikes a spherical mirror at the back. From here it is reflected forward to a photographic plate at the focal point. The Schmidt combines great concentration of light with a wide field of view.

Spy Glasses and Binoculars

The terrestrial telescope, or spy glass, is simply a refracting instrument suitable for use on land or sea. It always gives an erect image whereas an astronomical telescope usually gives an inverted image. In the 17th century, telescope makers produced the first erecting ocular for the telescope. This was a system of lenses which received the inverted image from the objective and reinverted it. Thus the image appeared right side up to the eye, once the instrument was brought into focus. Terrestrial telescopes are still made in this general form.

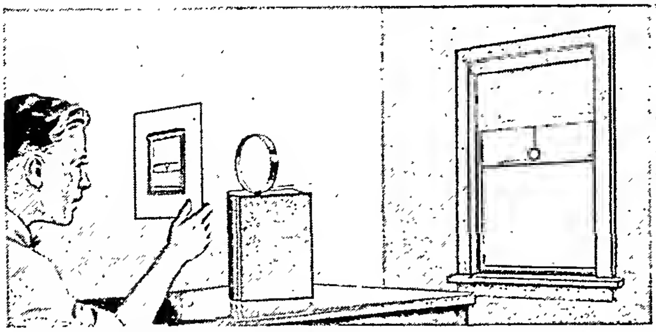
Several different types are in use today, and there are many varieties of each type. Single-tube telescopes are much used at sea, where they are called "long glasses." Instruments of this type are also used in sextants, transits, and telescopic rifle sights. Binocular telescopes (usually called "binoculars") are of two kinds, the "Galilean" and the *prismatic*. The first is simply a pair of small Galilean telescopes with simple lens arrangement. The second kind of binocular instrument uses reflecting prisms in the shape of triangular blocks of glass. These provide an erect image and also give the space needed for focus between the objective and the ocular by doubling the light back on itself twice. Opera glasses and inexpensive field glasses are of the so-called Galilean type. Fine binoculars, however, are always prismatic.

THE EYES OF THE FLEET

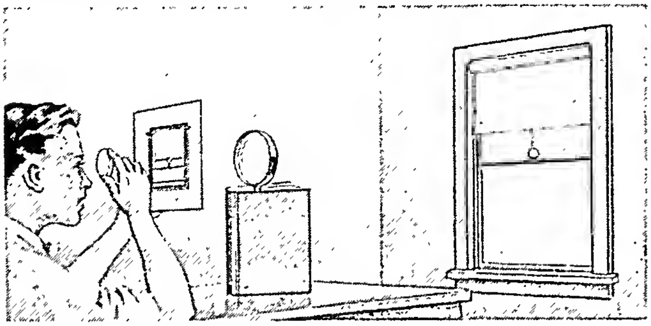


The United States Navy uses the finest telescopes available. The battleship captain at the left is scanning the horizon with a fine pair of seven-power binoculars. The signalman at the right is using a high-power *long glass* to read the signal flags on another ship.

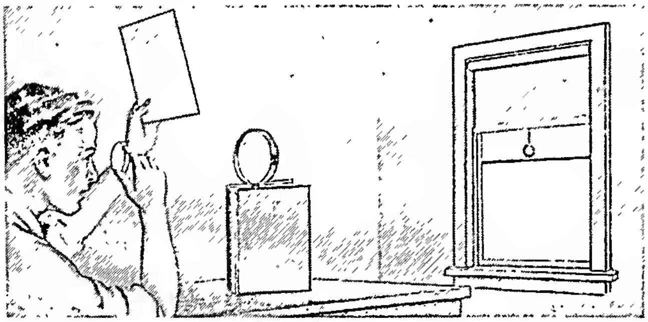
HOW DIFFERENT TELESCOPES WORK



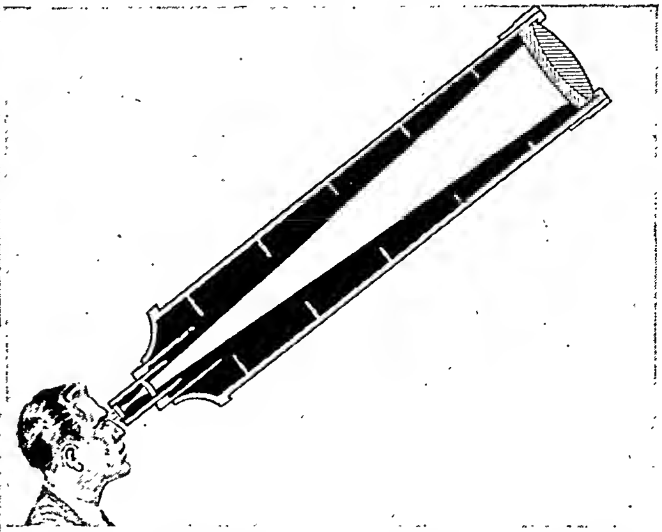
To demonstrate how a refracting telescope works, prop up a magnifying glass on a table. Hold a piece of thin paper behind the lens so that it catches a sharp image of a window or table lamp.



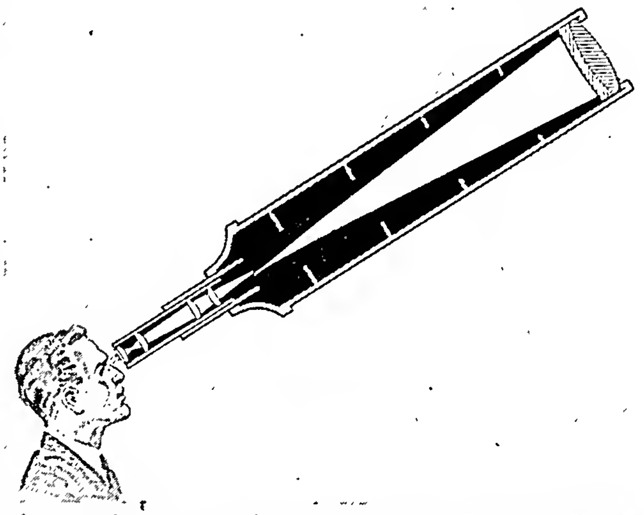
Now with another hand lens, magnify the upside-down image you see on the paper. To focus the second lens, move it back and forth until the magnified image is as sharp and clear as possible.



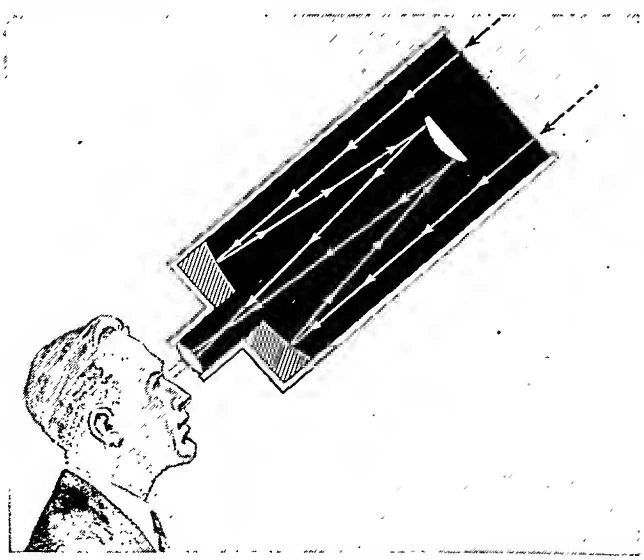
Keeping both lenses in position, whisk away the paper. What you now have is a telescope without a tube. It forms an upside-down (inverted) image, but this does not matter in astronomy.



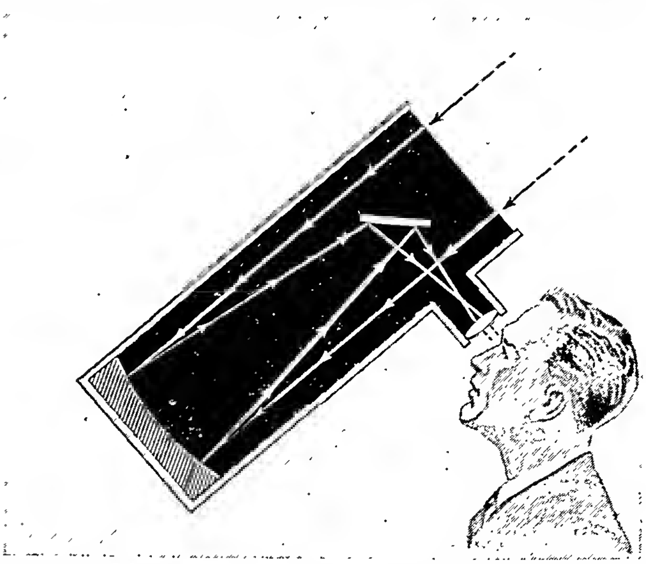
An astronomical telescope works on the principle demonstrated at the left. The lenses are compound to eliminate aberrations, and inside the tube are black diaphragms which catch stray light.



A terrestrial telescope, intended for use on land or at sea, has the same features as an astronomical telescope. But the eyepiece has additional lenses which erect the inverted image.



In all but the biggest reflecting telescopes, the observer's head would cut off too much light if the eyepiece were at the principal focus. In the Cassegrainian reflector, a small mirror turns the light back through a hole in the center of the big mirror.



In the Newtonian reflector, a small slanting mirror catches light from the objective mirror and turns it sidewise through an eyepiece to the observer. Many types of reflecting telescopes are in use. All are much shorter than comparable refractors.

SEEING *What Happens* EVERYWHERE *by* TELEVISION

Television brings exciting baseball broadcasts to millions of fans. Cameras stationed behind home plate and along the first- and third-base lines bring close-ups of action in the infield or follow the ball as the batter hits it into the outfield (right). An announcer's comments add interest to the television showing.

TELEVISION. Today millions of people can stay at home and enjoy entertainment that once could be seen only in theaters and sports arenas. They can have front-row seats at such important events as presidential inaugurations, Congressional hearings, and United Nations sessions. Television can bring these scenes to receivers located anywhere within range of a broadcasting station, even to moving trains and ships.

The word *television* comes from Greek and Latin words meaning "far seeing." We can "see" objects thousands of miles away because the television camera acts as our on-the-scene "eye." What the camera sees is repeated as a moving image on the television-receiver screen. Action is accompanied by sound so that we can hear as well as see. All this is made possible by widespread networks of television broadcasting stations serving millions of receivers in the United States.

Presenting and transmitting programs, and manufacturing, selling, and repairing television sets make up a huge industry in the United States. The cost of presenting a full-hour program over a national network on Sunday evening has run as high as $100,000. Nor is the limit of the industry's growth near. Large areas of the country still lack television service comparable to that offered by radio. Equipping and serving these new areas offers the television industry continued opportunity for expansion.

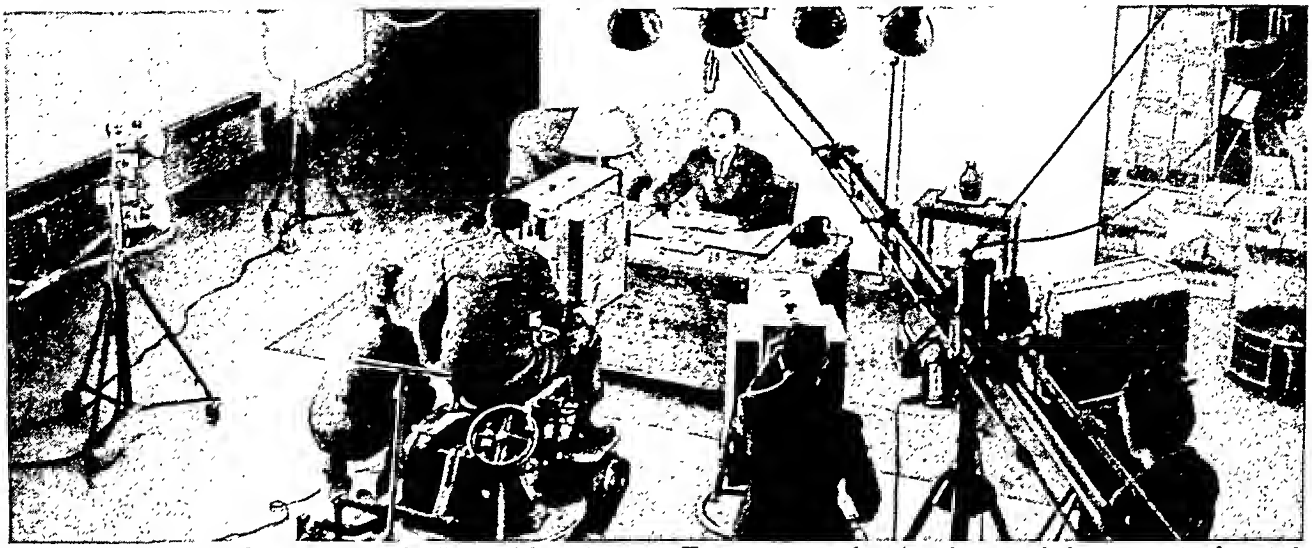
Television Programs and Their Sponsors

As told later in the article, television was developed by individual inventors and private companies. Most stations and all networks in the United States are owned by corporations. Some companies have an interest in the manufacture and sale of receiving sets; but most of them obtain income by renting their facilities by the minute or the hour to advertisers. The advertisers in turn present programs designed to have wide popular appeal.

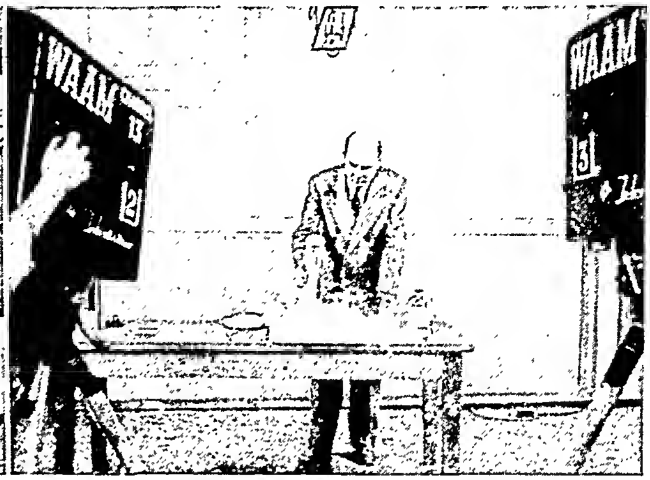
WATCHING THE GAME AT HOME

At home, fans can see details of play which sometimes are hidden even from spectators in the best box seats. This large receiver screen offers details comparable to that of a motion picture.

For pure entertainment there are musical, dramatic, and comedy shows. Sports fans can see many types of athletic contests. News and weather reports are regular features. Television also presents a wide selection of "how to do it" shows—cooking, home



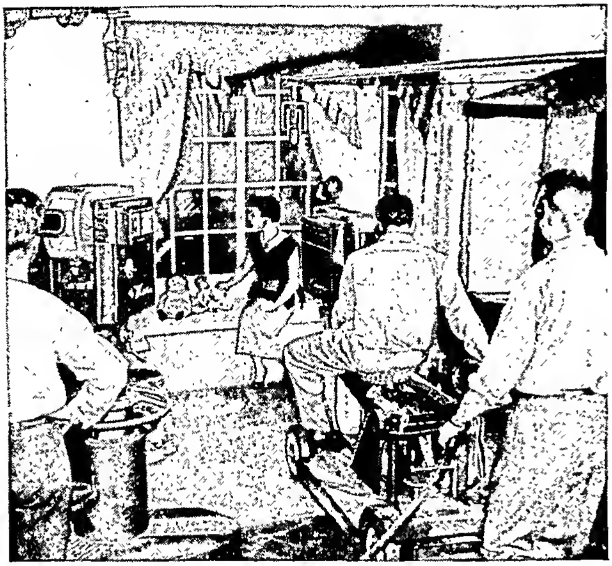
News broadcasts are an important part of daily television schedules. Here cameras and a microphone catch the comments of a noted news analyst. Two cameras are used to give changes of viewpoint to watchers. Notice how the batteries of lights bring details of the scene into full view. The setting may be permanent and used for a whole series of programs.



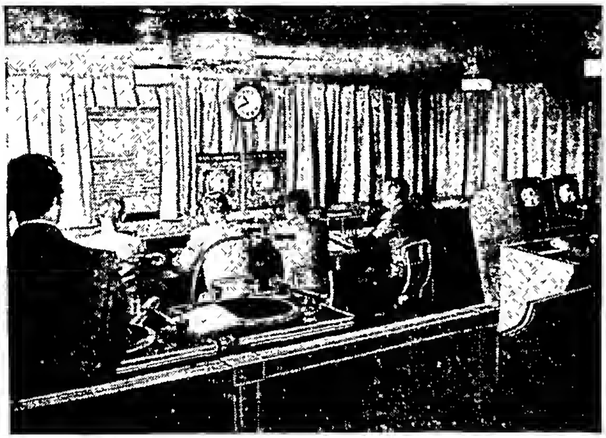
Puppets make fascinating television actors. This scene (left) shows last-minute preparations before a puppet program goes on the air. A "live" performer will also take part in the show. Notice how the puppet manipulators stand above camera range. Television can display visual education programs even better than students can see them in a classroom. Here (right) a university professor of physics conducts an experiment with dry ice. Such programs as these can be seen on national networks.

Many television programs combine popular music with comedy or a human-interest story. Here cameras move directly into a scene to show one part of the program, then another in swift sequence. The cameras can also hack away to show the whole scene.

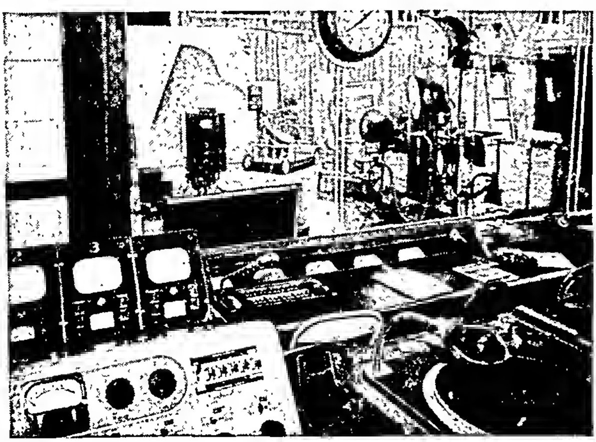
PRODUCING TELEVISION PROGRAMS



While the cameraman at right keeps the scene focused in view, his helper pushes the dolly and keeps the cable from snarling. The cameraman at left awaits his cue to begin work.



These control-booth men supervise what the audience sees and hears. The man standing is playing a background musical record. The first seated man regulates the sound quality; the next two regulate picture quality. At the right is the program director.



This studio is idle for the moment and no actors are present to hide anything. Equipment in the control booth and on the studio floor beyond the glass panel shows plainly. Dominating everything is a clock to help keep performances on schedule.

carpentry, household hints, and other demonstrations. Of educational interest are science demonstrations, visits to the zoo, and programs of a like nature.

Programs that show important news events as they occur often attract the largest audiences. In showing two events of this kind in 1951, television firmly established itself as a method of rendering public service. It brought the Senate crime-investigation hearings headed by Sen. Estes Kefauver to a national audience; and it broadcast the address of Gen. Douglas MacArthur before a joint meeting of the Senate and the House of Representatives. Public interest in both these programs foretold increasing use of television for bringing national affairs directly to the American people.

In addition to public uses, science and industry also employ television for research and observation. These showings are sent over "closed circuits" not available to ordinary receivers. Television can allow doctors and other interested people to observe a surgical operation on a receiver screen. With television, atomic scientists can study and control the handling of dangerous materials in safety. Military aircraft can televise scenes of enemy action. Pilotless aircraft and guided missiles can be controlled by television. Television cameras can be lowered deep into the ocean to observe undersea life or diver operations.

Where the Television Programs Begin

Except for sports and various special events, most television programs originate in studios. These are of three types. The first is an all-purpose studio, designed to provide ample room for movement of actors and equipment. The second is a theater studio, with seats for an audience. Often these are converted playhouses. The third type is one with fixed settings and equipment. These are used mainly for such programs as newscasts, where little physical action takes place and where the same setting may be used for an entire series of the same program.

All studios are equipped with cameras, microphones, batteries of lights, and settings and properties. Several cameras are used to give audiences a variety of views of the same scene. The cameras are mounted on *dollies* (wheeled stands). The television cameraman and his assistants can move the camera to follow action or to take a new station while other cameras are at work. Lift and tilt mechanisms on the camera mount add to the camera's freedom of movement. Several lenses mounted on a turret arrangement permit quick lens changes while the show is going on. One of these may be a *zoomar* lens, which can focus on objects far or near.

Radio microphones catch all accompanying sound. They hang at the end of long booms, out of camera range, and follow the performers as they move. For lighting, both fluorescent and incandescent lamps are used. Most of them hang from a permanent scaffolding or grid attached to the ceiling. This keeps the floor clear of cables and allows the performers and cameras free movement. Settings and properties are only complete enough to create the illusion of reality. For

televising events outside the studio, portable equipment is used.

In many ways television production is much like motion-picture work (*see* Motion Pictures). But there are important differences. A motion-picture studio head can spend a fortune on production because the film will be shown in thousands of theaters. A television show appears only once, and the cost must be held down accordingly. Most television programs are "live"—that is, actors present the program directly to the audience. If a mistake occurs the show cannot be stopped to correct it. Neither can a television producer prepare several versions of the same scene and choose the best one, as a motion-picture producer does. Movie film is "edited" by cutting or adding sequences; television programs must go out as originally presented.

Television can take advantage of movie techniques by actually filming a program—usually a dramatic play—in a movie studio. The film is then broadcast over television. But a filmed television program loses part of its visual quality in transmission, since what is received is actually a picture of a picture. And after a few showings over national networks most of the large television audience will have seen the film. For this limited number of showings the film has to be made cheaply.

Regular motion-picture films appear often on television. These are mainly older movies no longer wanted by theaters. A plan for showing new movies, called *phonevision,* was demonstrated experimentally in 1951. Only sets with special devices linked to the telephone system could receive the movies. Otherwise the picture and sound appeared in the set as "scrambled," presenting a meaningless jumble to the eye and ear. The subscriber notified the telephone company that he wished to view the movie; the company activated the device and billed the subscriber at a set rate for each movie.

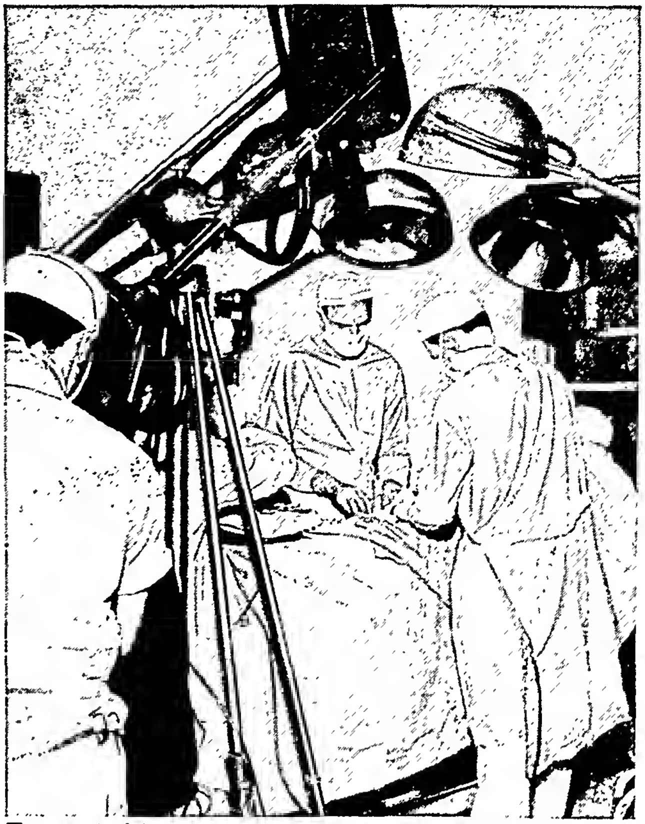
Another projected method for deriving revenue from television-set owners in return for showing new movies or other especially desirable programs was a coin-operated "unscrambling" device. The method was similar to phonevision, except that the subscriber would deposit a coin to activate the device. These experiments foreshadowed the growing realization that competition between movies and television would have to be compromised by some such method.

How Television Works

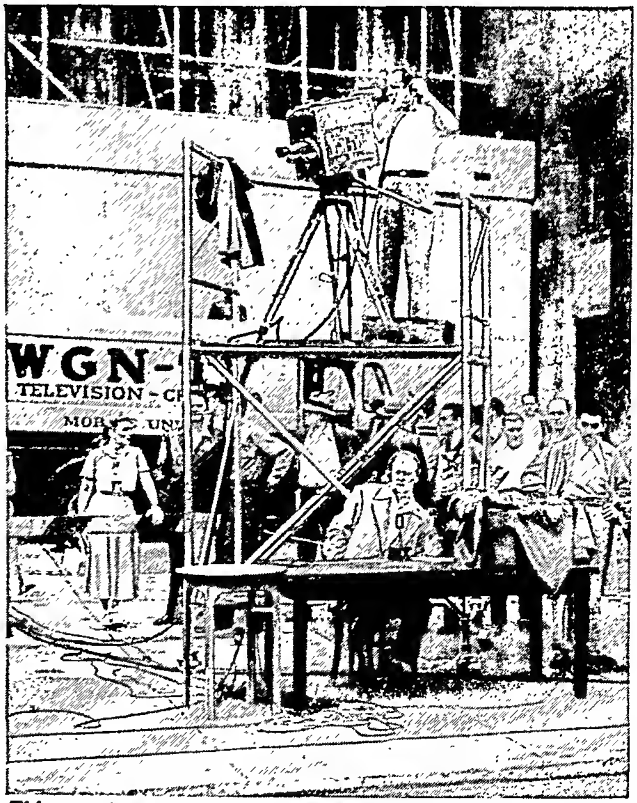
WHEREVER there is light, we can see objects because they reflect light into our eyes. This light actually carries an *image* of the object. Each point of the image registers in the retina on one of the innumerable nerve endings called rods and cones. The rods and cones turn the light and shadow of the image into nerve impulses and send them through the optic nerves to the brain.

The television camera also can "see" this image, and it turns each point of light and shadow into electric pulses. It collects these pulses in series and

TELECASTING SPECIAL EVENTS



Here a television camera is hung directly over an operating table to show doctors new surgery techniques. Programs such as these are usually broadcast over "closed circuits" and can be seen only on specially adjusted receivers.



This portable equipment is ready to telecast a parade which will pass in a few minutes. An announcer is seated and ready to comment. Several such temporary stations may be set up along the parade route, using power sources from near-by buildings.

impresses them on a radio carrier wave to be sent out through the air.

The television receiver reverses the action. The radio wave recreates the pulse series, and these are turned back into the lights and shadows of the image on the receiver screen. All this takes place many times a second. It works fast enough to "freeze" the motion of the actual scene as successive "stills." These are sent in rapid succession and blend to give the illusion of motion. In much the same way, the separate frames of motion-picture film blend to show continuous motion.

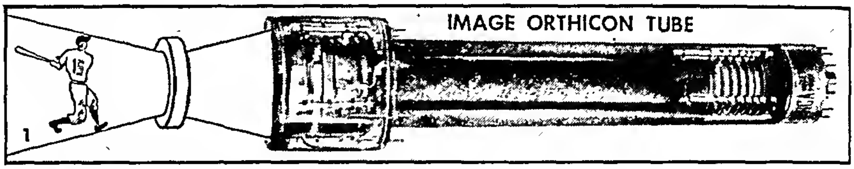
To transform the image into a series of pulses, the camera is equipped with an Image Orthicon tube, as shown on this page. A lens focuses the image on a transparent plate just inside the tube. On its inner surface the plate has a metallic coating. This coating is *photosensitive,* that is, when struck by light it gives up electrons. Each point or element on the coating thus acts something like the rods and cones in the retina of the eye. The number of electrons given up depends upon the strength of light hitting the element.

These released electrons are drawn to a thin glass *target plate* by the force of the anode (positive charge) wall coating in the tube. The target plate is at first neutral, but as electrons strike the near side they knock off other electrons by a process called *secondary emission.* A fine-mesh screen draws off these displaced electrons. This leaves a positive charge on the target plate. The glass is thin enough for the positive charge to exert force through the plate. The positive charge pattern is thus an electric equivalent of the image. A strongly charged point is a bright spot on the image; a weak charge is a spot of shadow.

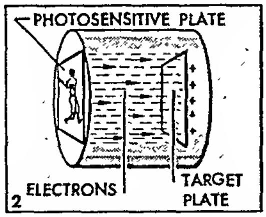
A scanning beam of electrons starts from a cathode (called an *electron gun*) at the base of the tube. The beam is only strong enough to come near the target plate before a positive charge on the electron multiplier turns it and draws it back as a *return* beam. But at the turn enough electrons fly off to neutralize each positive charge. The scanning beam moves left to right and so on down the plate, depositing electrons at each positive charge. The left-over electrons at each point then return along the beam. The ever-changing number of electrons amounts to varying pulses of negative charge in the beam.

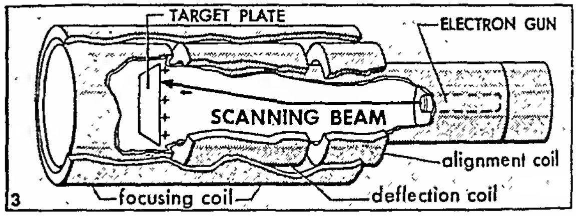
The target plate has 525 lines of positive-charge elements. Guided by deflection coils, the scanning beam neutralizes the even-numbered lines on its first trip down the plate and the odd-numbered lines on the second. Each set of lines is called a *field;* the two

HOW THE TELEVISION CAMERA WORKS



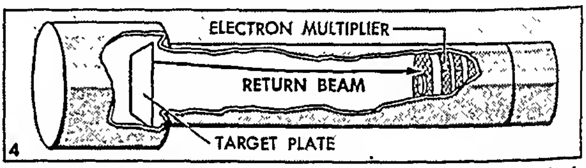
1. Transmitting the television picture begins when the camera lens focuses the image in this Image Orthicon tube. Here the lights and shadows of the image are converted to electronic pulses of corresponding strengths. The tube is about 15 inches long.



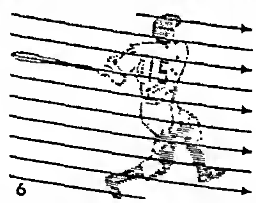


2. Inside the tube the image strikes a photosensitive plate and releases electrons from the metallic coating, as explained in the article. Electrons are released according to the strength of light hitting each point. The electrons fly to the target plate and knock off other electrons, leaving a point-by-point pattern of positive charges.

3. The positive charge pattern now carries the "picture information." To draw off this "information" point by point, an electron beam *scans* the target and neutralizes each charge in turn. The path of the beam in scanning is shown in diagrams 5 and 6 below. The beam comes from an electron source and is narrowed down by the focusing coil. Deflection coils move the beam across and down the plate. Beam action will be repeated in the receiver to re-create the picture, as shown on the next page.

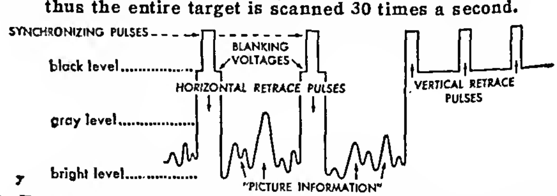


4. The scanning beam comes near the plate, then is drawn back by the electron multiplier as a return beam. But as the beam turns at each point it passes, it leaves enough electrons to neutralize the positive charge at that point. The left-over electrons in the return beam indicate the strength of the charges and thus of the image itself. The beam is strengthened by the electron multiplier and made ready for transmission as a video signal.



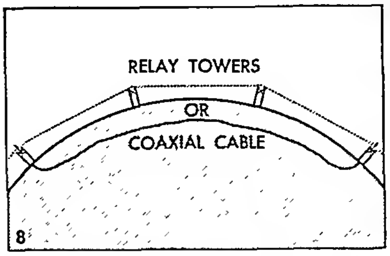
5. The target plate holds 525 lines, each with positive charges along it. To neutralize these charges the scanning beam makes two trips down the plate. On the first it scans only even-numbered lines; on the second, odd-numbered lines. Diagram 5 shows the beam path on the first trip. The right-to-left lines are horizontal retraces that return the beam to position for scanning the next line it traverses.

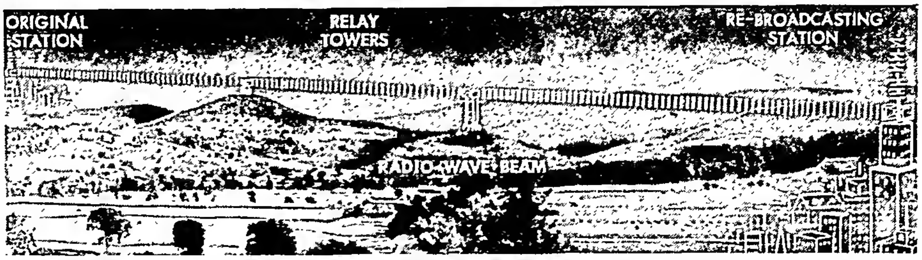
6. In this diagram the second trip is shown in odd-numbered lines and the first trip (seen in diagram 5) is shown in even lines. The second set *interlaces* the first for complete scanning. Each set of lines (odd or even) is scanned 60 times a second; thus the entire target is scanned 30 times a second.



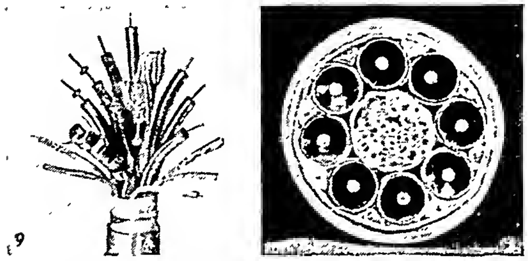
7. For transmission the video signal *modulates* a high-frequency radio wave. This graph shows how the last two lines scanned are impressed on the wave. The curved portions contain the "picture information." The tall straight lines mark horizontal retraces. The voltage (called a *blanking* voltage) is high enough to prevent these parts of the signal from showing on the screen. Synchronizing pulses keep the receiver in step with the transmitter. At the right are *vertical retrace* pulses that return the beam to the top of the plate after scanning a set of lines.

HOW TELEVISION PROGRAMS ARE RECEIVED

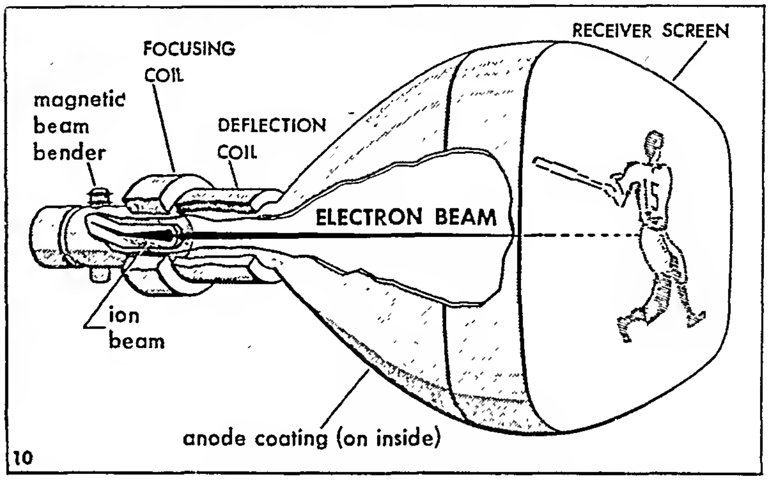


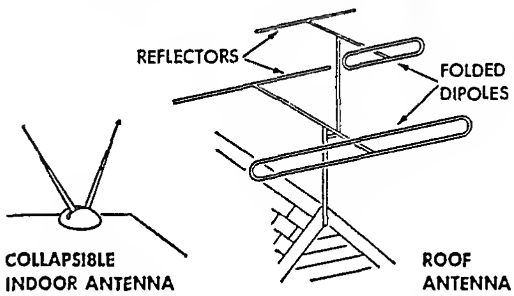


8. High-frequency radio waves used for carrying television signals do not follow the curved surface of the earth. They travel in a straight line and soon shoot off into space. But the waves can be focused into a beam. Then a station near the limit of the beam's travel can receive it and send a new one in the desired direction. This action can be repeated through a chain of such relay stations. Another relay method uses a coaxial cable. The left-hand picture shows relay towers spaced along an exaggerated curve of the earth. The right-hand picture shows how the towers might look from an airplane.



9. These pictures show a fanned-out portion of an 8-tube coaxial cable and a cross section.





10. Inside the receiver, this cathode-ray tube (or kinescope) reproduces the image. An electron beam traces the picture on the phosphorescent face of the screen. The beam moves exactly like the scanning beam of the camera tube, making light or dark spots just as the scanning beam caught them. These actions are controlled by the "picture information" in the video signal. How the ion trap, magnetic beam bender, and anode coating help is explained in the article. At the left are two types of receiving antennas.

together are called a *frame*. The beam scans 60 fields a second, or a total of 30 frames a second.

The return beam pulses, carrying the "picture information," pass through electrical circuits which produce a *video signal*. Included in it are synchronizing and retrace pulses that will keep the receiver in step with the camera. Meantime, microphones at the scene of action capture accompanying sound and turn it into a pulse series called an *audio signal*. (*Video* and *audio* come from Latin words meaning "I see" and "I hear.")

For transmission the video signal is impressed on a radio carrier wave by amplitude-modulation methods; the audio signal is impressed on another wave by frequency-modulation methods. (For an explanation of amplitude and frequency modulation, *see* Radio.) These are sent out together on high-frequency radio waves that occupy a band or channel six megacycles wide. High frequencies are used partly because the lower frequencies are already taken up by standard radio, and also because high frequencies are fairly free from static and other interference.

But high-frequency radio waves do not follow the earth's curvature, as do lower frequencies. Instead, they shoot off straight into space. Thus telecasting antennas can only serve receivers within horizon distance. For transmission beyond this point the waves are beamed from point to point by relay stations or are carried by coaxial cables. Both relay-station and coaxial-cable transmission can carry other signals besides television—telephone messages, for example.

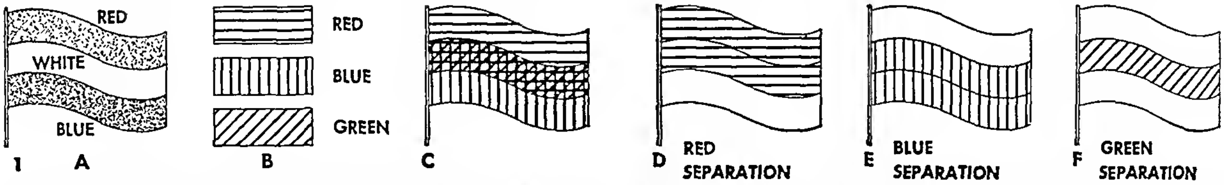
Twelve channels were originally assigned to television, located in the 54–72, 76–88, and 174–216 megacycle bands. In 1952 the Federal Communications Commission announced the opening of 70 new channels, located in ultra-high-frequency ranges. The total of 82 channels provides for a maximum of well over 2,000 stations. When in operation, these stations will bring television to every part of the nation. Many channels are reserved for educational use.

How the Receiver Shows the Image

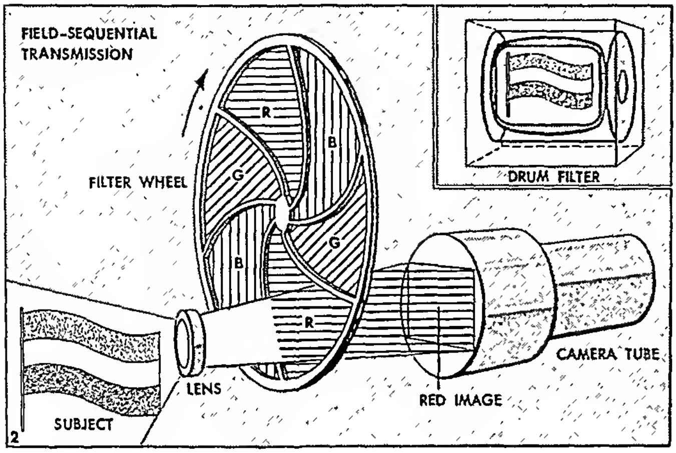
A receiving antenna captures the broadcast wave and carries it down to the set. A large building may have a master antenna to serve many sets. These antennas are made in various shapes and sizes, but most of them are a combination of *dipoles* that actually catch the wave and *reflectors* that reflect waves into the dipole. The dipole may be straight or folded (looped). Inside the set the video and audio signals are separated by special electrical circuits. The audio signal is amplified and turned into sound in the speaker.

After amplification the video signal passes into the *cathode-ray tube*, or *kinescope*. This is the heart of the television receiver. Action begins as the cathode

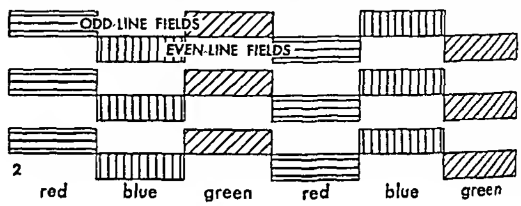
HOW TELEVISION TRANSMITS FULL-COLOR PICTURES

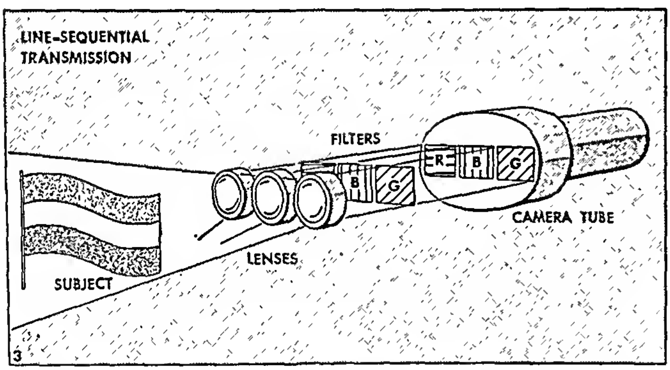


1. All colors of light can be imitated by various combinations of three light colors: red, blue, and green. Thus the flag shown in A is actually made up of the primary colors shown in B. Put together in C as primary colors, we can see the red and blue as before. But the white is shown as a combination of all three primaries, because white light actually contains all the colors of the spectrum. For transmission, a full-color image of this flag must first be separated into the primary light colors, as shown in D, E, and F. How this can be done is shown below.

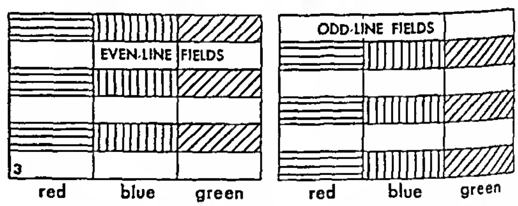


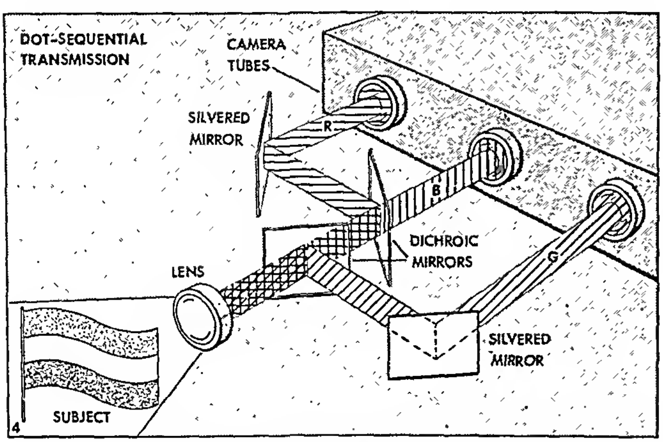
2. This system uses a filter wheel to separate the image into primary colors. The wheel has sectors for each color, and it spins at high speed between the camera lens and the Orthicon tube. As each filter sector crosses the beam of light it passes all intensities of its own color which exist in the actual scene and blocks all other colors. Each one-color image is scanned just like a black-and-white image, except that the odd-line scanning of one color is followed by the even-line scanning of the next. The scanning beam must scan six fields in order to cover all three colors, as shown below. Each field is transmitted in order; hence the system is called "field sequential." An alternate to the filter wheel is the drum arrangement shown in the smaller picture.



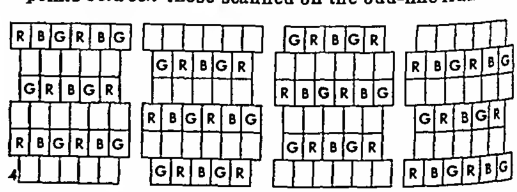


3. Here the image is broken up into its primary light colors by an arrangement of lenses and filters. Then all three one-color images pass into the camera tube where they are aligned side by side on the target plate. The scanning beam moves horizontally over all three, instead of scanning one field completely before it goes on to the next. Thus a line of red is followed by a line of blue, then one of green. This explains the name "line sequential." The chart below shows the sequence of lines.





4. Here an arrangement of mirrors separates the image into its primary colors. The separating is done by *dichroic mirrors*. These are made in such a way as to reflect all shades of one primary color from the surface, while letting all shades of the other colors pass through as though the mirror were made of clear glass. Thus the colors of the scene are separated into reflected beams and ones which go straight through the mirrors. Each separated beam enters its own tube, and all three color images are scanned simultaneously. An extremely high-speed electronic switch (not shown) takes off "sample signals" from each scanning beam to form what amounts to a dot-by-dot pattern; hence the name "dot sequential." For close scanning, the even-line frames are scanned at points *between* those scanned on the odd-line frames.



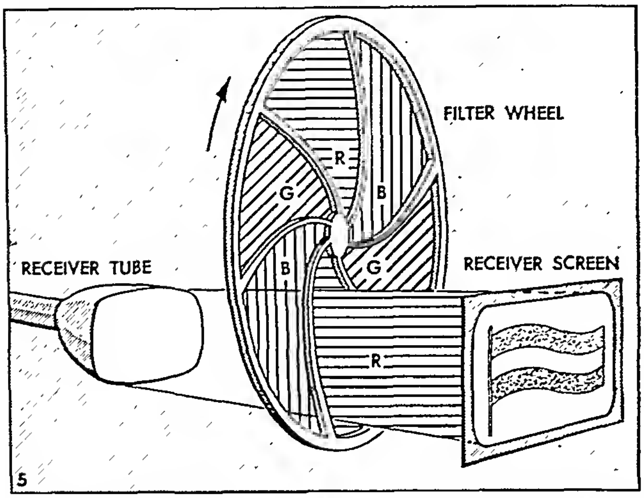
The drawings on these two pages show various systems for transmitting and receiving full-color television broadcasts. Final acceptance by broadcasters and the public of any one of these systems—or combinations of any of their features—depends in part on how well each system works and in part on three other factors: (1) *Adaptability*—can existing sets be modified to receive color broadcasts in black and white? (2) *Compatibility*—can existing sets receive color broadcasts in black and white without modification? (3) *Convertibility*—can existing sets be modified to receive color broadcasts in color?

produces a stream of electrons. The "picture information" of the video signal goes into a *grid* that regulates the strength of the stream. The synchronizing pulses go to the deflection plates or coils; and these make the beam follow the same path as the scanning beam in the camera tube. One or more anodes speed up the passage of electrons in the beam. The face of the cathode-ray tube is coated with a phosphorescent material that gives off light when struck by the electron beam. Thus as the beam scans the face, or screen, it re-creates a picture of the original image. (*See also* Electronics.)

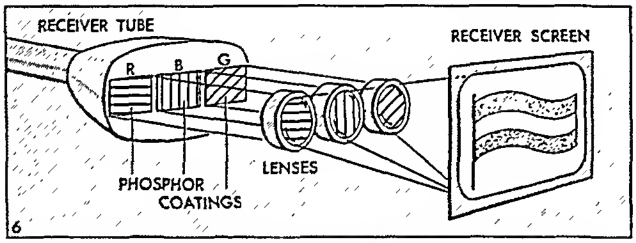
Even though the tube is highly vacuumized (evacuated), some gas particles may remain. These become ionized and may mix with the electron beam. To draw off these ionized particles, an *ion trap* is set. The whole beam starts off on a slant until it meets the magnetic *beam bender*. The beam bender turns the electrons into the correct path but is not strong enough to affect the ions. These continue off at a slant until they hit the anode coating inside the neck of the tube. The coating conducts the ions back to the cathode. The anode coating also conducts back electrons that bounce off the face of the screen.

All these fundamental actions of the camera and receiver are accomplished with the aid of complex intermediate electrical circuits. Many principles that govern the action of these circuits are described in the articles on Electricity and Radio.

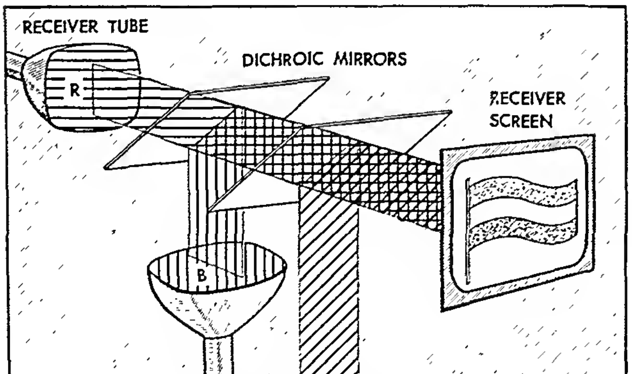
RECEIVING A FULL-COLOR PICTURE



5. For receiving field-sequential transmissions, a filter wheel in the receiver works in time with its counterpart in the transmitter. The separate one-color images are traced on the receiver-tube face, then passed through the appropriate filter to the viewing screen. There they register one on top of the other at high speed and blend into the full-color image.



6. The line-sequential transmissions are traced on a receiver-tube face divided into three areas as in the camera tube. But here each area is coated with a special chemical called a *phosphor*. When scanned by the beam each phosphor area glows in its own primary color. The glowing one-color images are focused together on the viewing screen.



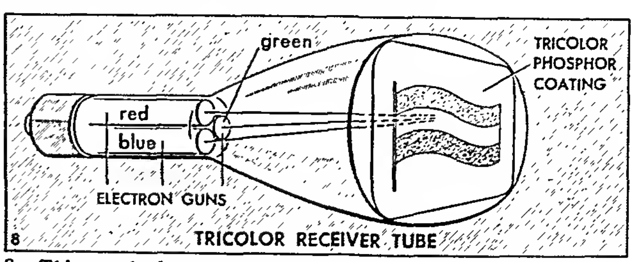
7. One method of receiving dot-sequential transmissions makes use of three separate receiver tubes. The face of each tube is coated in a phosphor of a primary color. The phosphor glows when struck by the electron beam. Each beam works in time with its counterpart in the camera, tracing separate one-color images. Then the images are brought together by dichroic mirrors, and the full-color picture appears on the face of the screen. An alternate method is shown in the picture at right.

Color Television

The ordinary television camera takes in an image composed of light and shadow reflected from the subject; and the photosensitive plate registers the image according to the intensity of this light and shadow. Color does not matter except as it affects this intensity. Thus the ordinary television camera is "color blind." It "sees" color only as various intensities of gray.

Despite this "color blindness" a television camera can be adapted to transmit images in full color. This can be done because of the nature of color itself.

As explained in the article on Color, light coming from the sun (or an electrical or chemical source) contains all the colors of the spectrum. This great variety of hues can, however, be imitated by combinations of three *primary light* colors. These are blue-violet, yellow-green, and red-orange, or more simply, blue, green, and red. (The article on Color explains the difference between *light* colors and *pigment* colors.) Mixed in proper proportions, these primaries can produce pure, or white, light.



8. This method uses only one *tricolor* tube. Three scanning beams work in step with the camera-tube beams. They sweep the tube face together; but only one deposits electrons at any one instant. The tube face is coated with closely aligned triangles of phosphor dots. Each triangle has a primary color dot in position to be hit by its own beam. When the beam strikes the correct dot the whole triangle glows in the proper color. The glowing triangles form the full colors of the original.

When this white light, containing the mixture of primary light colors, hits a multicolored object, two actions take place. The object reflects the part of the light containing its own colors, and it absorbs the rest. Thus an image is reflected light carrying only the colors of the object.

If we hold a primary red filter in front of our eyes, it lets all red hues from the image pass through and absorbs the others. Similarly a primary blue or green filter passes only its own colors.

Color television makes use of the fact that full-color images can be divided into separate one-color images. These are scanned and sent out in much the same way as are black-and-white television images. The receiver restores the right color to the separations and blends them back into the full-color image on the screen. The pictures on the previous pages show various ways that this action can take place.

Swift Progress of Color Television

Research on color television over many years led to a demonstration broadcast over a small area of New York City in 1945. By 1949 various systems were far enough advanced for the Federal Communications Commission to consider licensing commercial color broadcasts. The commission aimed to choose one system which would then set standards for the whole industry. For about a year the FCC reviewed the systems shown on the previous pages. They were judged on fineness of picture detail, the number of pictures (frames) transmitted each second, and fidelity of color reproduction. The commission also considered whether existing sets could remain in use.

In 1950 the FCC selected the field-sequential method developed by the Columbia Broadcasting System as being most satisfactory in total performance. Its principal drawback was that it was not *compatible;* that is, existing sets could not receive color broadcasts in black and white pictures without modification. Dr. Peter Goldmark led Columbia's research program. Other claimants for recognition sued to upset the FCC selection; but a federal district court in 1950 and the United States Supreme Court in 1951 upheld the decision. The way remained open for modification of the basic method and for probable use of features from other systems. One such feature was the tricolor tube from the dot-sequential system developed by the Radio Corporation of America. From 1951 to 1953 production of color television equipment was halted at the request of the office of Defense Mobilization in order to save critical materials.

Recording Television Broadcasts

A television program can be recorded on film and reshown many times. The film can then be rebroadcast in the same manner as transcribed radio programs are used. The film can also be shown in movie theaters or preserved as an historical record. The television image is received in the ordinary way and photographed as it appears on the screen. A highly synchronized motion-picture camera, using 16-mm. film, takes the pictures. These are filmed at the standard rate of 24 frames a second. Sound is recorded on film, and positive prints are made by the same process as in motion-picture films. (*See also* Motion Pictures.)

An extension of this is Ultrafax, a trade name for a method of sending facsimile copies of all kinds by ultrahigh-frequency television transmission. With this device letters, legal documents, signatures, diagrams, and similar papers can be sent from point to point at high speed in their original form. The papers can be full size or reduced to microfilm for even faster transmission. The receiving camera moves the film continuously and has no intermittent motion. The film is developed and fixed in less than a minute, and prints can be made to any desired size. A projected use is to broadcast whole newspapers to home receivers which would be equipped with rolls of sensitized paper.

Development of Modern Television

By the late 1800's inventors had made a good start toward achieving television. In 1873 Willoughby Smith had noticed that selenium conducts a stronger electric current when more light strikes it. In 1884 Paul Nipkow of Germany used this property for television by wire. He scanned moving images with holes set along a spiral in a whirling disk and let the varying light from different parts of the image fall upon a selenium cell. A reverse arrangement with a lamp instead of the cell reproduced the image.

The images remained feeble and limited in range, however, until 1925. Then C. Francis Jenkins and John L. Baird amplified them with vacuum tubes. Soon afterward the cathode-ray tube replaced the perforated disk for receiving. Between 1924 and 1933 Vladimir Zworykin developed the iconoscope for scanning. Similar devices were invented in the same period by Philo T. Farnsworth and François Henroteau.

Since about 1930, television programs have been broadcast in Europe. In the United States commercial broadcasts and sale of receivers were delayed until

CHECKING FILM ON A TELEVISION RECORDER

This inspector is studying the sharpness of the television image focused on the film. The recording camera is open at the left.

various major problems could be solved. One was the problem of a standard method of transmission to make sure that sets made by various manufacturers would all be able to receive the same programs. A standard code was adopted in 1941, and commercial broadcasting began. This code standardized the number of scanning lines in the picture at 525 and required that 30 complete pictures be transmitted every second. It also determined the shape of the picture by setting its height equal to three fourths its length.

In 1953 tests proved that a three-dimensional television could be achieved by stereoscopic methods. Two images were required, and viewers wore special glasses.

Television Creates New Problems

The swift growth of television brought problems similar to those that accompanied the growth of radio (*see* Radio, subhead "Social Problems Created by Radio"). One was the effect of television on children. Television's vivid reality tended to keep them from more varied, active occupations and encroached on time normally spent in home study. One answer lay in parental control of viewing hours; another in teaching the place of television in a day properly divided into work or study, outdoor play, and indoor recreation.

Television brought a steady decline in the number of movie patrons at all except the most outstanding motion-picture showings. The motion-picture industry attempted to answer the challenge by producing better pictures and also by supplying films for television. In 1951 one large movie company bought a major television network. Another move was for theater chains to buy exclusive rights to receive a television broadcast of an outstanding prize fight and to project the televised showing on their theater screens. Patrons bought tickets for the showing as though for a regular movie. But movie attendance continued to drop, and a steady number of smaller theaters in large cities went out of business.

As a new vocational field television offered wide employment opportunities. Training in electronics provided the best background for the technical work of television. Dramatic training and theatrical experience helped to qualify performers for the new art of television acting. Writers, directors, scene designers, and musicians found their education and experience valuable in creating television shows.

At first these workers used techniques borrowed from radio, night clubs, movies, and the stage. But gradually they learned that television was capable of becoming an entertainment form in its own right. They learned to key their performances to the level suited for home entertainment and to use techniques based on the versatility of the television camera.

HOW THE CRUEL GESSLER DIED

The legend of William Tell is told with many different endings. According to the version pictured here, Gessler continued to oppress the people, and Tell was called upon to rid them of the tyrant. Lying in wait along a forest road, he shot and killed Gessler with an arrow from his crossbow.

TELL, WILLIAM. Early in the 14th century, legends say, the village of Altdorf in Switzerland was ruled by a tyrannical Austrian governor named Gessler. One day he placed a hat on top of a pole as a symbol of Austrian power. The people were ordered to bow to it as though it were the Duke of Austria. A skilled crossbowman named William Tell refused to do this. Soldiers took him and his son Walter before Gessler. The cruel Gessler ordered Tell to shoot an apple off Walter's head at a hundred paces. If Tell refused, Gessler added, both he and the boy would die.

Tell took an arrow from his quiver and slipped it under his belt. Then he took another and fired it from his bow. The arrow pierced the apple. Gessler asked Tell what the first arrow had been intended for. "To slay you, tyrant, had I killed my son."

In a rage Gessler commanded his soldiers to carry Tell to prison. Tell escaped during a storm, and soon thereafter he slew Gessler. Swiss legends place these

events in the year 1307. Soon after, in 1315, the men of the three forest-cantons, Uri, Schwyz, and Unterwalden, defeated an invading Austrian army and then renewed and enlarged the Perpetual League, which helped lay the foundation of Swiss independence.

The story was long accepted as true, but Swiss historians have proved it to be one of those patriotic legends that grow up in every land. A similar story is told of Egil, in Scandinavian legend; of Eindridi and of Hemingr, in Norse legends; of Toki, the Danish hero, and of William of Cloudesley, Adam Bell, and Clym of the Clough, in English ballads. William Tell made his first appearance in Swiss literature in the second half of the 15th century. The German poet Schiller made the legend the subject of a drama, and the Italian composer Rossini used it in an opera.

TEMPERANCE. At first "temperance" meant merely the movement to secure moderation in the use of intoxicating drinks. Gradually its scope extended to include total abstinence from their use ("teetotalism"). The first temperance society in the United States was formed at Litchfield, Conn., in 1789, by 200 farmers who pledged themselves not to give strong liquors to workmen on their farms. Early in the 19th century the churches took a hand. The Massachusetts Temperance Society was begun in 1813 and the American Temperance Union in 1826. The early societies advocated temperance, but not total abstinence. They did not object to wine, cider, or malt liquors. The temperance reformers even built a brewery in Boston as a means of combating the use of distilled liquors. The first national temperance convention met in Philadelphia in 1833 and formed a national temperance union, with 23 state societies and over 7,000 other societies as members. During the Civil War the temperance cause received a serious setback. After the war, the growth of breweries and saloons brought the temperance question again before the people. Most temperance organizations in the United States came to include in their program not only total abstinence but also rigid control of the liquor traffic and its suppression by either local option or national prohibition. Thus the temperance movement became identified in large measure with the prohibition movement. (*See also* Prohibition; Woman's Christian Temperance Union.)

'TEMPEST, THE'. On an island in the Mediterranean Sea, according to this romantic play by Shakespeare, lives an exiled duke of Milan, Prospero, with no companions save his lovely daughter Miranda, and his books of philosophy and magic. By his magical knowledge, he brings into his service an ugly, half-human creature called Caliban, and the fairy spirit Ariel. One day Prospero discerns a ship blown toward the island, and knowing by his magic that the King and the Prince of Naples, as well as his own false brother, the usurper of his dukedom, are on board, he sends Ariel to wash them into the sea and land them safely on different parts of the island. It is Prospero's hope to bring about a marriage between Miranda, whom he has tutored with care from her infancy, and the young Prince of Naples. To his great joy not only do the youthful pair, as soon as they meet, fall to adoring each other, but the King himself is delighted and restores to Prospero his dukedom. At the end, Prospero breaks his magic wand and sets free the delicate, powerful spirit, Ariel, or Imagination, who sings in sweet and lilting tones:

> Where the bee sucks, there suck I:
> In a cowslip's bell I lie;
> There I couch where owls do cry.
> On the bat's back I do fly
> After summer merrily.
> Merrily, merrily shall I live now
> Under the blossom that hangs on the bough.

Some people like to think that Prospero is Shakespeare who, with this play, laid down his pen forever.

The "VOLUNTEER" STATE—*Its Corn, Cotton, and Coal*

TENNESSEE. A long narrow strip of land wedged in among eight states forms the state of Tennessee. It extends 448 miles from the Mississippi River eastward into the Appalachian Mountains. Its three natural divisions are East, Middle, and West Tennessee. The Cumberland Plateau marks the division between East and Middle Tennessee; the lower Tennessee River separates Middle and West Tennessee.

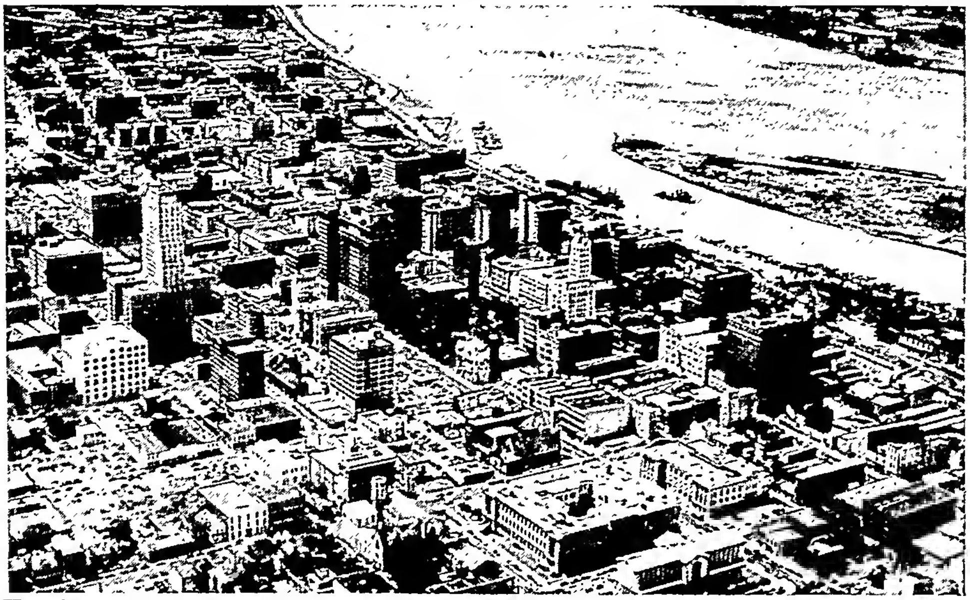
East Tennessee is a valley 30 to 60 miles wide, formed by the southwestward extension of the Great Appalachian Valley, called here the Valley of East Tennessee. It lies between the steep slope of the Cumberland Plateau on the west and the Great Smoky Mountains on the east. The Cumberland Plateau is the most southwestern part of the Appalachians. In the Smokies a large area of rugged, forest-covered peaks and deep ravines is preserved in its natural state as the Great Smoky Mountain National Park. In the Smokies is the highest point in the state. This is Clingmans Dome, 6,642 feet high. From East Tennessee rise many of the state's large rivers. Minor ridges and valleys furrow East Tennessee. Portions of the mountainous sections are unproductive, but most of the eastern valley is as fertile as the rich lands of middle and western Tennessee.

Three of the largest cities of the state are in this valley—Knoxville, Oak Ridge, and Chattanooga. Knoxville lies on the upper Tennessee River. It grew around a small fort built by Gen. James White in 1786. During the 20th century, it developed rapidly in commercial and industrial importance. Today most of the state's marble is quarried around Knoxville. Other large industries are the manufacture of knit cotton goods and men's clothing (*see* Knoxville).

Oak Ridge, the "atomic city," is about 20 miles west of Knoxville. The federal government built it in World War II to prepare material for atomic bombs. It is one of the state's larger cities.

Eighty miles southwest on the Tennessee River is the thriving city of Chattanooga. As a gateway between

MEMPHIS ON THE MISSISSIPPI



Here is the downtown district of Memphis, the largest city in Tennessee. It is also one of the nation's greatest inland ports and world's largest cotton market and hardwood lumber center.

Tennessee, Alabama, and Georgia, this city was a strategic point in the Civil War (*see* Chattanooga, Battle of). Vast hydroelectric power available here, with adjacent forests, and deposits of coal, iron, and other minerals, makes Chattanooga one of the great cities of the new South (*see* Chattanooga).

The Cumberland Plateau, abruptly rising 900 to 2,000 feet above the valley, is rich in mineral springs, water power, coal, iron, and other minerals. Its southern end is deeply cut by the Sequatchie Valley.

The "Garden Valley" of Middle Tennessee

Middle Tennessee, dropping abruptly from the irregular jagged edge of the Cumberland Plateau, is for the most part a level plateau furrowed by many ravines and streams. It is called the Highland Rim. It slopes down to the Nashville, or Central, Basin, an elliptical depression of about 6,600 square miles that extends nearly across the state from northeast to southwest. This is the "garden of Tennessee," containing the finest farming lands. In its northwestern part, on the Cumberland River, is Nashville, the capital and second largest city (*see* Nashville).

Beyond the valley of the Lower Tennessee, the western part of the state (called the Jackson Purchase) slopes down to the Mississippi River. The plain ends in a line of bluffs overlooking the alluvial bottom lands—low, marshy, and studded with lakes. Memphis, the largest city, is built on a bluff overlooking the Mississippi River in the southwest (*see* Memphis).

Tennessee has about 1,200 miles of navigable streams. These have been important factors in the development of the state, long providing the chief means of transportation. The Mississippi, Tennessee, and Cumberland rivers (the last two tributaries of the Ohio) form the chief drainage basins. The Tennessee flows 652 miles from the junction of the French Broad and Holston rivers above Knoxville. With the Holston it crosses the state twice in a 792-mile course. It flows southwest to Chattanooga, swings around in a broad curve through northern Alabama, re-enters Tennessee, and then heads north to join the Ohio at Paducah, Ky. The name of the river comes from Indian words which one legend says mean "big bend." The state is often called the "Big Bend State." A series of dams on the Tennessee and its tributaries maintains a nine-foot channel from Knoxville to Paducah (*see* Tennessee Valley Authority).

The Cumberland River, rising in the Cumberland Mountains in southeastern Kentucky, follows a U-shaped course in the northern part of the state and flows back into Kentucky, entering the Ohio River not far from the Tennessee, 715 miles from its source. Along this river is some of the most beautiful scenery in America. On its way down from the highlands it forms Cumberland Falls, with a vertical drop of about 66 feet. A few miles farther on it rushes through a gorge whose walls rise 300 feet or more. A series of government locks and dams make the river navigable the entire year from Nashville to its mouth, a distance of 193 miles. Large power plants on its

CHATTANOOGA FROM LOOKOUT MOUNTAIN

Lookout Mountain, a Civil War battle site, presents a grand view of Chattanooga and the Moccasin Bend of the Tennessee.

tributaries are Center Hill and Great Falls dams on the Caney Fork and Dale Hollow Dam on the Obey.

Farming in Tennessee

Some 75 per cent of Tennessee is in farms. The climate is ideal for farming. The growing season varies from 180 days in the fertile Great Appalachian Valley to 261 days in the Mississippi bottoms. The Nashville Basin in midstate also has excellent farms. Rainfall is ample, averaging 50 inches a year. Summers are hot, and winters short and mild. Almost every temperate zone field crop, fruit, and vegetable thrives in the protected valleys. Erosion is extensive, but reforestation and flood- and erosion-control have increased crop yields.

Corn is the most valuable farm crop, but most of it is used on the farm for feed or seed. Cotton and tobacco are the leading cash crops. Tennessee is among the first five states in tobacco production. Other important products are milk, hogs, hay, cattle, and eggs. Livestock raising is rapidly expanding.

Tennessee's Resources and Manufactures

Tennessee has about 30 commercially important minerals. It is one of the nation's main sources of phosphate, ceramic clays, pyrites for sulfuric acid, and marble. It is the chief source of zinc, copper ores, and pyrites in the South.

The most valuable mineral is bituminous coal, mined extensively in the Cumberland Plateau. Zinc is also produced in East Tennessee. Phosphate rock is found in Middle Tennessee. The state's phosphate output ranks second only to that of Florida.

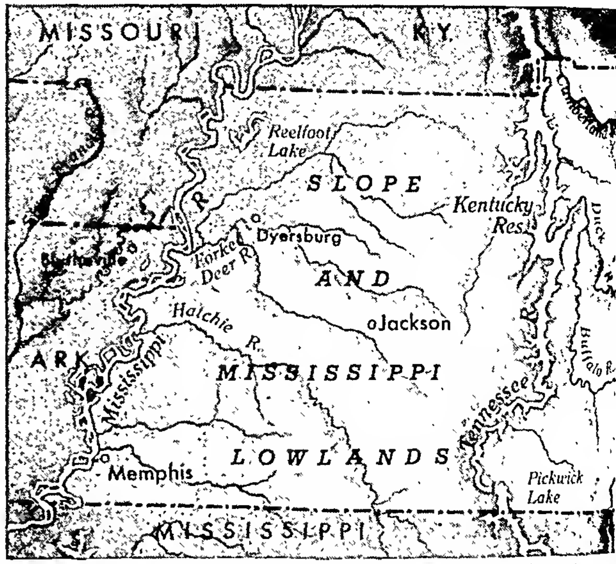
The limestone and dolomite deposits in the middle and eastern parts of the state supply a large cement industry. The quarries in the east yield world-famous fine marble. Knoxville is the center of the marble industry. Ball clays and other ceramic clays of West Tennessee are the chief sources for the nation's ceramic industries. The Ducktown Basin in the state's southeastern corner is the only major copper producer in the South and the largest producer of pyrites in the United States. Sand and gravel are also important.

Forests of oak, chestnut, hickory, cedar, pine, gum, and many other trees cover about half the state. Lumber and wood products are important manufactures. Memphis is one of the nation's hardwood centers.

Improved transportation and low-cost electricity supplied by the Tennessee Valley Authority have led to a rapid development in manufacturing, especially in East Tennessee. The largest industry is the manufacture of chemicals. Its chief products are rayon and nylon fibers and many industrial chemicals. Another large industry is the manufacture of cotton and rayon textile products. There are many large knitting mills throughout the state. Tennessee is second only to North Carolina in manufacturing seamless hosiery.

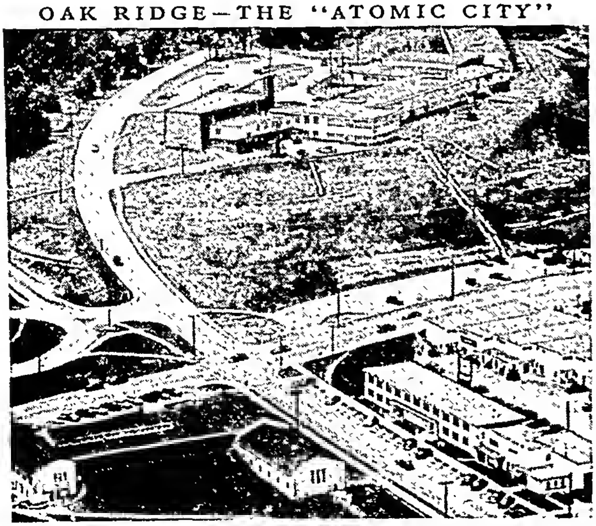
Huge establishments in the state include the aluminum plant at Alcoa, the cellophane-rayon plant near Nashville, the atomic energy plants at Oak Ridge, the Air Force research project at Tullahoma, and the rayon plants at Elizabethton.

Tennessee has a sizable income from the tourists who come to view TVA reservoirs, the Great Smoky Mountains National Park, and the scenic landscape.



Tennessee's land surface is extremely varied. It calls its natural regions the three grand divisions—*East Tennessee*

OAK RIDGE—THE "ATOMIC CITY"

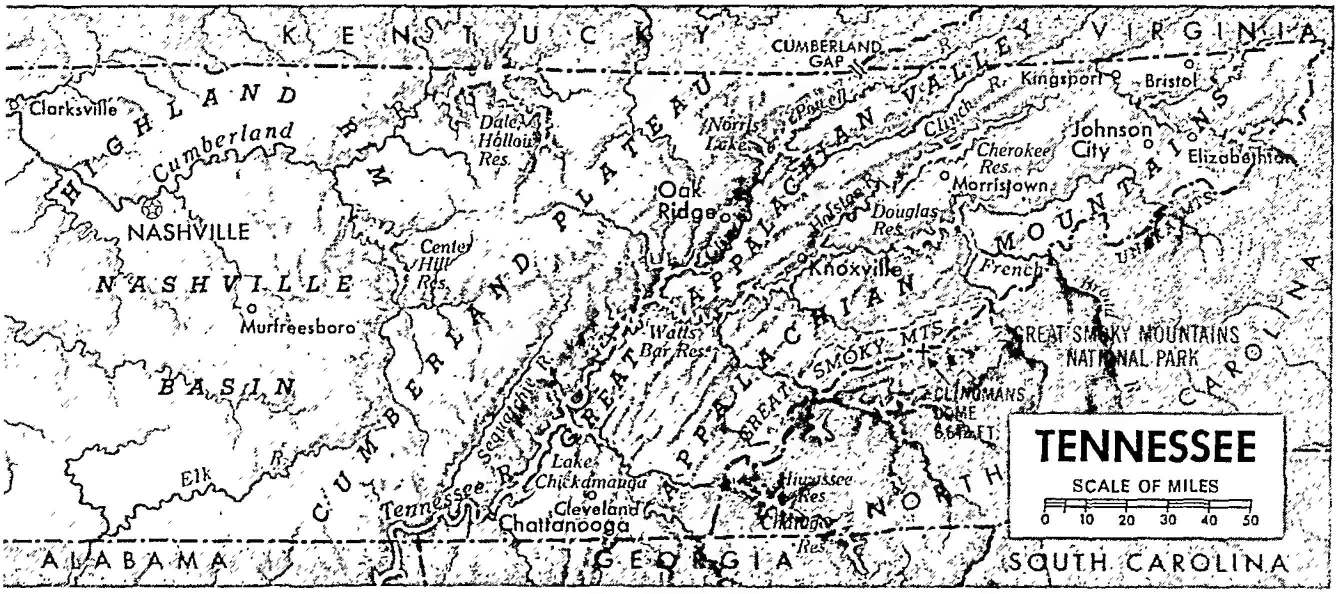


The federal government built Oak Ridge in 1943 to house workers in atomic plants. It is now one of the state's largest cities. The Atomic Energy Commission owns and administers the city.

Education and Government

The University of Tennessee at Knoxville is the head of the state system of education. It maintains a medical school at Memphis and branches at Nashville and Martin. There are state colleges in Johnson City, Murfreesboro, Clarksville, and Memphis. Tennessee Polytechnic Institute is in Cookeville. George Peabody College for Teachers, Vanderbilt University, Ward-Belmont School, Fisk University (for Negroes), and Tennessee Agricultural and Industrial State University (for Negroes) are in Nashville.

Tennessee's constitution, adopted in 1870, had provided so complicated an amendment procedure that every effort to change it failed for 83 years. Finally in 1953 the voters ratified amendments including revi-



from the Mississippi to the Tennessee River; *Middle Tennessee*, to the rising Cumberland Plateau; and *West Tennessee* to the crest of the scenic Great Smoky Mountains. The three stars on the state's flag represent these three sections of the state.

sions of the amending process. The General Assembly consists of a senate and a house of representatives. No clergymen are eligible for either house.

The State's Long History

The first white explorers in Tennessee found the Cherokee in the east, the Chickamauga and Creek in the south, and the Chickasaw in the west. When De Soto marched from Florida to the Mississippi in 1541, he probably entered Tennessee (*see* De Soto).

Nearly a century later, La Salle traversed the Mississippi from its junction with the Illinois to its mouth and claimed the territory of Louisiana, named for Louis XIV of France. He built Fort Prudhomme in 1682 where Memphis stands (*see* La Salle).

French dominion in Tennessee was challenged by the English. In 1690 Cornelius Doherty of Virginia visited the Cherokee, and James Adair lived among them 1735-75. In 1748 Thomas Walker led a party across Cumberland Gap to hunt along the Cumberland River. Daniel Boone and other hunters from English colonies soon moved into this region (*see* Boone). The English built Fort Loudoun on the Little Tennessee River, about 30 miles from the present city of Knoxville, in 1756. Four years later the Cherokee destroyed it. At the close of the French and Indian War in 1763, England gained control of this land.

William Bean, a Virginian, started the first permanent settlement in Tennessee on the Watauga River in 1769. Other settlers from Virginia, South Carolina, and Regulators from North Carolina poured into the Holston Valley along the Nolichucky River (*see* North Carolina). Finding themselves in Indian territory, set aside by the British, and without land titles, the Watauga settlers decided to form an association to lease their lands from the Indians. Inspired by two men, John Sevier and James Robertson, they met in 1772 and formed the Watauga Association. They adopted one of the early plans of self-government west of the Alleghenies (*see* Sevier).

At the start of the American Revolution, the Watauga people asked to be annexed to North Carolina as the Washington District. Led by Sevier and Isaac Shelby they defeated the British at Kings Mountain in South Carolina.

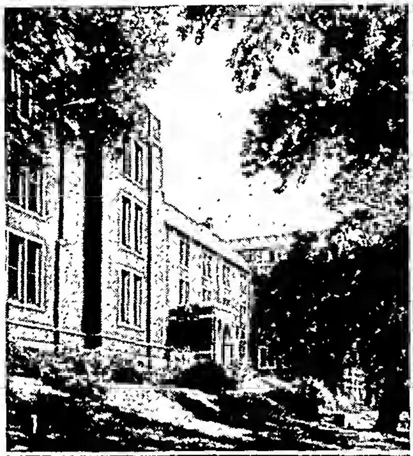
After the war, North Carolina offered the Tennessee region to the federal government. Angered by this and menaced by Indians and Spaniards, the settlers organized a new state. The name "Frankland" was proposed, but they called it "Franklin." Congress and North Carolina ignored it. A second offer by North Carolina in 1790 was accepted by the federal government. After six years as a territory Tennessee entered the Union in 1796 as the 16th state, with Sevier as its first governor.

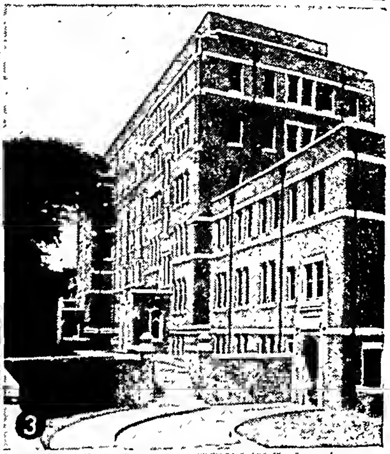
In the Mexican War Tennessee was nicknamed the "Volunteer State" when 30,000 men answered a call for 2,800 troops. Before the Civil War the state opposed secession, but after its outbreak it joined the Confederacy. Led by Andrew Johnson the eastern and some central counties organized a Union government.

Tennessee witnessed more battles in the Civil War than any state except Virginia (*see* Civil War, American). These included Shiloh, Stones River, Chattanooga, Nashville, and Memphis. The state gave 115,000 soldiers to the Confederate armies, and eastern Tennessee sent 31,000 to the Union forces.

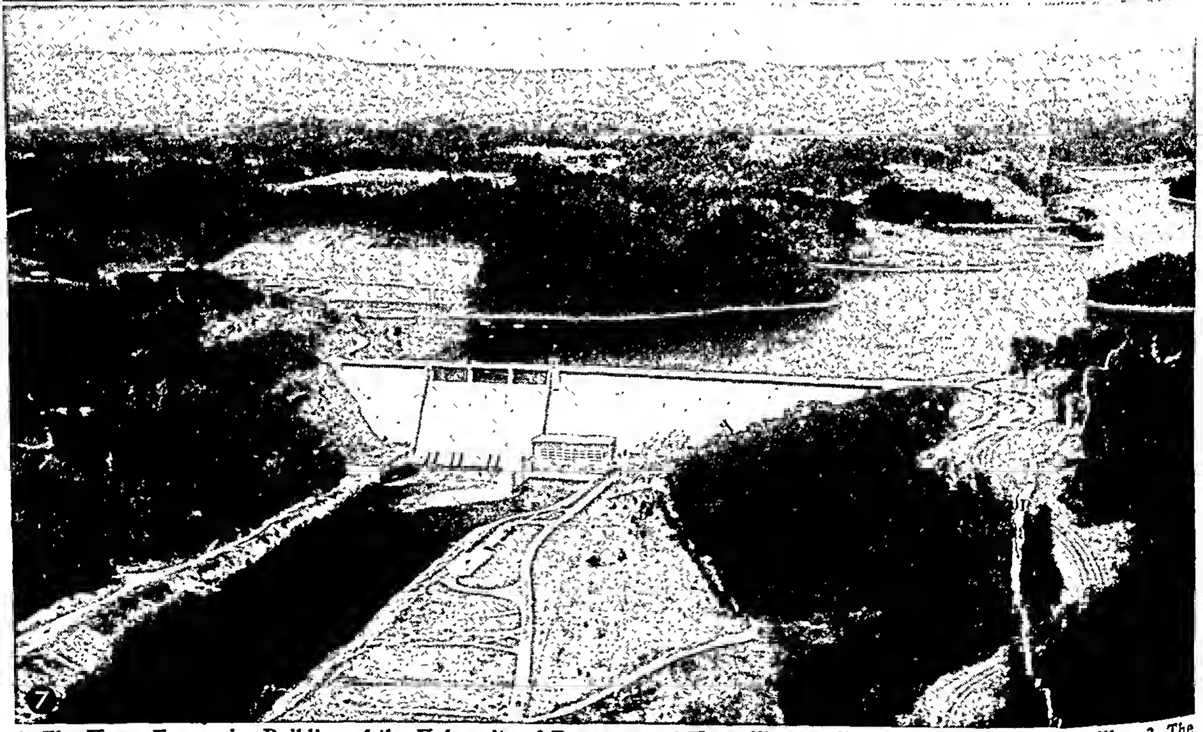
Tennessee was the first state to be readmitted to the Union (July 24, 1866). While it escaped the rule of the "carpetbaggers," the vote was confined to those whites who had been loyal to the Union and to the Negroes. The Ku Klux Klan was organized at Pulaski in 1865 to maintain white supremacy. Reconstruction after the war was a tremendous task (*see* Reconstruction Period). Since then Tennessee has made progress in agriculture, mining, and manufacturing. The TVA, created in 1933, has helped greatly. (*See also* Tennessee Valley Authority; chronology in Tennessee Fact Summary; United States, section "The South.")

THESE BRING FAME AND FORTUNE TO TENNESSEE









1. The Home Economics Building of the University of Tennessee at Knoxville. 2. The State Capitol in Nashville. 3. The hospital of the Vanderbilt University School of Medicine at Nashville. 4. Skeins of rayon being laced by automatic machines at the Old Hickory plant of the Du Pont Company. 5. A quarry of fine building marble near Knoxville. 6. A field of tobacco. 7. An air view, by Fairchild Aerial Surveys, of Norris Dam, part of the Tennessee Valley Authority project.

Tennessee Fact Summary

TENNESSEE (Tenn.): Named from Indian word, *Tenassee*, for capital of Cherokee nation.

Nickname: "Volunteer State," from the thousands of Tennesseeans who promptly answered the governor's call for men to serve in Mexican War.

Seal: Plough, wheat, cotton plant above; boat below.

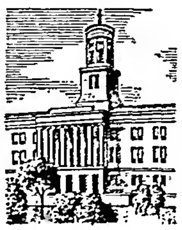
Motto: Agriculture and Commerce.

Flag: For description and illustration, *see* Flags.

Flower: Iris. **Bird:** Mockingbird. **Tree:** Tulip poplar.

Songs: 'My Homeland, Tennessee'—words, Nell Grayson Taylor; music, Roy Lamont Smith; adopted 1925; and 'When It's Iris Time in Tennessee'—words and music, Willa Mae Waid; adopted 1935. Both official.

THE GOVERNMENT



Capital: Nashville (since 1843).

Representation in Congress: Senate, 2; House of Representatives, 9. Electoral. votes, 11.

General Assembly: Senators, 33; term, 2 years. Representatives, 99; term, 2 years. Convenes first Monday in January in the odd-numbered years. No limit to session, but only 75 days with pay.

Constitution: Adopted 1870. Amendment must be agreed to by majority of all members of General Assembly and by two thirds of all members in next session and ratified by majority of those voting for governor. Amended also if voters approve a convention and ratify proposed amendment (both by majority vote of those voting); no convention oftener than 6 years.

Governor: Term, 4 yrs. Not eligible for succeeding term.

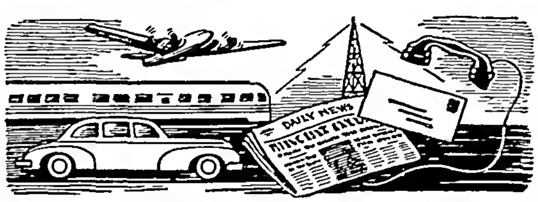
Other Executive Officers: Secretary of state, treasurer, comptroller, all appointed by General Assembly; terms, 4, 2, and 2 years respectively; adj. gen., appointed by governor; term, at governor's pleasure; atty. gen., appointed by supreme court; term, 8 years.

Judiciary: Supreme court—5 judges. Court of appeals—9 judges. Chancery courts—14 divisions; circuit courts—20 circuits. Judges elected; term, 8 years.

County: 95 counties; 90 have quarterly courts serving as legislative bodies; members elected for 6-year terms. Other counties have commissions or county councils.

Municipal: Mayor and alderman plan; commission plan.

Voting Qualifications: Age, 21; residence in state, 1 year; in county, 3 months.



TRANSPORTATION AND COMMUNICATION

Transportation: Railroads, 3,500 miles. First railroad, La Grange and Memphis (6 miles of track out of Memphis), 1842. Rural roads, 64,300 miles. Airports, 63.

Communication: Periodicals, 120. Newspapers, 165. First newspaper, *Gazette*, Rogersville (later at Knoxville), 1791. Radio stations (AM and FM), 64; first station, WKN, Memphis, licensed March 23, 1922. Television stations, 4; first station, WMCT, Memphis, began operation Dec. 11, 1948. Telephones, 749,000. Post offices, 785.

THE PEOPLE AND THEIR LAND

Population (1950 census): 3,291,718 (rank among 48 states—16th); urban, 44.1%; rural, 55.9%. Density: 78.8 persons per square mile (rank—16th state).

Extent: Area, 42,244 square miles, including 447 square miles of water surface (33d state in size).

Elevation: Highest, Clingmans Dome, 6,642 feet in Great Smoky Mountains National Park; lowest, Mississippi River at southwest corner of state, 182 feet.

Temperature (° F.): Average—annual, 59°; winter, 40°; spring, 58°; summer, 76°; fall, 60°. Lowest, −32° (Mountain City, Dec. 30, 1917); highest, 113° (Perryville, Aug. 9, 1930, and other locations and earlier dates).

Precipitation: Average (inches)—annual, 50; winter, 14; spring, 14; summer, 13; fall, 9. Varies from about 44 in northeast to about 60 in southeast.

Natural Features: Three regions—East Tennessee (Appalachian Mountains, Great Appalachian Valley, Cumberland Plateau); Middle Tennessee (Highland Rim, Nashville Basin); West Tennessee (Slope, Mississippi lowlands). Principal rivers: Tennessee, Cumberland, Mississippi.

Land Use: Cropland, 26%; nonforested pasture, 17%; forest, 45%; other (roads, parks, game refuges, wasteland, cities, etc.), 12%.

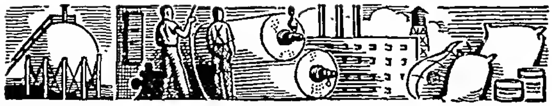
Natural Resources: *Agricultural*—land and climate suited to growing corn, cotton, hay, and tobacco. *Industrial*—forests; marble quarries; limestone and clay for cement; coal, pyrites, copper, zinc, sand and gravel, clays, and phosphate rock; hydroelectric power. *Commercial*—natural waterways.

OCCUPATIONS AND PRODUCTS

What the People Do to Earn a Living

Major Industries and Occupations, 1950

Fields of Employment	Number Employed	Percentage of Total Employed
Agriculture, forestry, and fishery..	248,805	21.9
Manufacturing................	239,427	21.1
Wholesale and retail trade.......	193,228	17.0
Professional services (medical, legal, educational, etc.)..........	85,215	7.5
Personal services (hotel, domestic, laundering, etc.)............	83,107	7.3
Construction..................	79,984	7.0
Transportation, communication, and other public utilities.......	75,751	6.7
Government..................	37,423	3.3
Finance, insurance, and real estate	25,678	2.3
Business and repair services......	23,630	2.1
Mining......................	14,447	1.3
Amusement, recreation, and related services..................	7,964	0.7
Workers not accounted for.......	20,987	1.8
Total employed..............	1,135,646	100.0

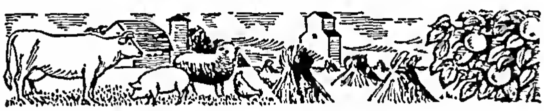


What the People Produce

A. Manufactured Goods (Rank among states—20th)
Value added by manufacture* (1952), $1,317,583,000

Leading Industries in 1947 (with Principal Products)	Value Added by Manufacture	Rank among States
CHEMICALS AND ALLIED PRODUCTS. Synthetic fibers; industrial chemicals; drugs and medicines	$162,578,000	12
FOOD AND KINDRED PRODUCTS..... Bakery products; animal feeds	132,489,000	22
TEXTILE MILL PRODUCTS.........	121,294,000	12
PRIMARY METAL INDUSTRIES...... Blast furnace, steel mill and iron and steel foundry products	86,104,000	15
FABRICATED METAL PRODUCTS..... Heating and plumbing equipment	52,607,000	16

*For explanation of value added by manufacture, *see* Census.



B. Farm Products (Rank among states—25th)
Total cash income (1952), $524,570,000

Products	Amount Produced (10-Year Average)	Rank within State*	Rank among States†
Corn...........	65,294,000 bu.	1	12
Milk...........	1,001,000,000 qts.	2	16
Cotton lint.....	559,000 bales	3	9
Hogs...........	377,555,000 lbs.	4	13
Hay...........	2,211,000 tons	5	20
Tobacco........	126,185,000 lbs.	6	4
Cattle..........	289,727,000 lbs.	7	21
Eggs...........	84,000,000 doz.	8	19

*Rank in dollar value †Rank in units produced

C. Fish (Rank among states—26th)
(Mississippi River and tributaries, 1950), catch, 20,529,000 lbs.; value, $1,428,000

D. Minerals (Fuels, Metals, and Stone)
Annual value (1951), $99,854,000
Rank among states—26th

Minerals (1951)	Amount Produced	Value
Coal.................	5,401,000 tons	$26,956,000
Cement..............	7,163,000 bbls.	17,203,000
Stone................	8,839,000 tons	14,766,000
Zinc.................	39,000 tons	14,065,000
Phosphate rock.......	1,420,000 tons	10,605,000

E. Lumber (Rank among states—14th)
748,000,000 board feet (5-year average)

F. Trade

Trade (1948)	Sales	Rank among States
Wholesale..........	$3,494,601,000	12
Retail.............	2,088,439,000	20
Service............	178,305,000	20

EDUCATION

Public Schools: Elementary, 3,656; secondary, 489. Compulsory school age, 7 through 16. State Board of Education composed of the governor and 10 members whom he appoints—commissioner of education, and 9 others, 3 from each grand division (a geographic region). County boards of education composed of 7 members elected by county courts for 7-year terms, unless special act provides for election by popular vote. County supts. elected by county court or by popular vote when provided for by special act. City supts. appointed by city boards.

Private and Parochial Schools: 113.

Colleges and Universities (accredited): Colleges—white, 26; Negro, 5. Junior colleges—white, 6; Negro, 2. State-supported schools include the Univ. of Tennessee, at Knoxville, Nashville, Memphis, and Martin; Tenn. Polytechnic Institute, Cookeville; Tenn. Agricultural and Industrial State University (for Negroes), Nashville; 4 state colleges—East Tennessee, Johnson City; Austin Peay, Clarksville; Middle Tennessee, Murfreesboro; Memphis State, Memphis.

Special State Schools: School for the Blind, and Tennessee Industrial School, both at Nashville; School for the Deaf, Knoxville.

Libraries: City and town public libraries, 30; 72 county libraries—63 are served by 8 regional libraries, 9 are independent; 1 county contracts for service with city library, 2 counties, with County Board of Education. State Library and Archives Commission aids in developing rural libraries (through Regional Libraries Consultant and Field Librarian), State Dept. of Education aids school libraries (through Supervisor of School Libraries). Noted Libraries: State Library and Disciples of Christ Historical Society, both at Nashville; TVA Technical Library, Knoxville; Goodwyn Inst., Memphis; Oak Ridge Inst. of Nuclear Studies.

Outstanding Museums: Brooks Memorial Art Gallery and Memphis Museum, both at Memphis; Children's Museum and State Memorial Museum, both at Nashville.

CORRECTIONAL AND PENAL INSTITUTIONS

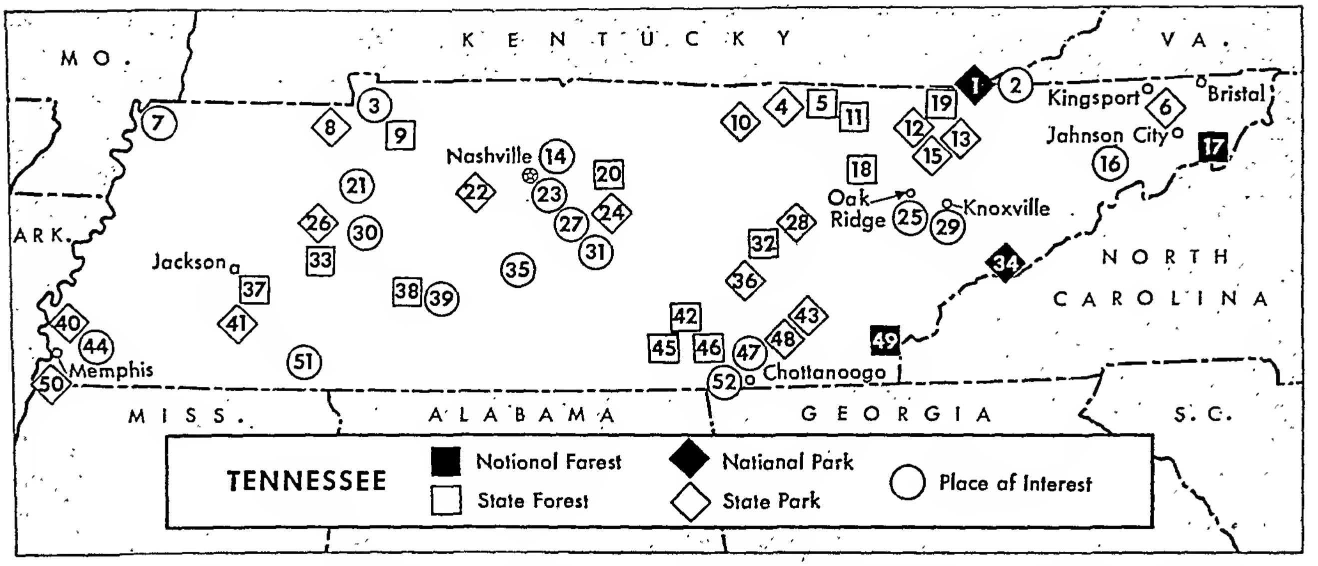
Vocational Schools for Girls—at Tullahoma (white) and Nashville (Negro). Training and Agricultural Schools for Boys—at Nashville (white) and Pikeville (Negro). State Farm, Fort Pillow; Brushy Mountain Penitentiary, Petros; State Penitentiary, Nashville.

PLACES OF INTEREST*

Andrew Johnson National Monument—Greeneville; home, tailor shop, and grave of the president (16).
Chattanooga—many Civil War historic sites and scenic attractions nearby (*see* Chattanooga) (47).
Chickamauga and Chattanooga National Military Park—Civil War battle positions well marked (52).
Fort Donelson National Military Park—fort captured by Gen. Grant in 1862; natl. cemetery; near Dover (3).
Hermitage—Andrew Jackson's home and tomb (14).
James K. Polk Memorial Home—Columbia; home of the president with relics and portraits (35).
Kentucky Reservoir—great man-made lake extending across Tennessee south-north; fishing (30).
Knoxville—Blount Mansion (1792); grave of John Sevier; University of Tennessee (*see* Knoxville) (29).
Lincoln Memorial University—Harrogate; museum collection of president's letters, personal effects (2).

*Numbers in parentheses are keyed to map.

Tennessee Fact Summary



Memphis—cotton market; Pink Palace, natural history museum; Beale Street (*see* Memphis) (44).
Meriwether Lewis National Monument—grave of co-leader of Lewis and Clark Expedition (39).
Nashville—State Capitol and museum; replica of Fort Nashborough; the Parthenon (*see* Nashville) (23).
Natchez Trace Parkway—old Indian Trail, Nashville-Natchez, Miss.; about 450 miles when completed (23).
Nathan Bedford Forrest Memorial Park—Camden; memorializes Confederate defeat of Union gunboats (21).
Oak Ridge—American Museum of Atomic Energy (25).
Reelfoot Lake—near Tiptonville; lake created by earthquake of 1811-12; state game and fish preserve (7).
Sam Davis Memorial Home—Smyrna; birthplace of Confederate hero; period furnishings (27).
Shiloh National Military Park—near Savannah; battle of Shiloh (1862); Indian mounds; natl. cemetery (51).
Stones River National Military Park—near Murfreesboro; Civil War battle (1862-63); natl. cemetery (31).
(On the Tennessee River and its branches are many TVA dams, including Pickwick, Chickamauga, Watts Bar, Fort Loudoun, Douglas, Cherokee, Hales Bar, Norris, South Holston, Watauga; *see* Tennessee Valley Authority).

STATE PARKS*

Big Ridge—hilly, wooded shore on Norris Lake (13).
Booker T. Washington—recreation area for Negroes on beautiful Chickamauga Lake (48).
Cedars of Lebanon—red cedar; limestone caverns (24).
Chickasaw—2 lakes in forested recreational area (41).
Cove Lake—an arm of Norris Lake in scenic valley (12).
Cumberland Mountain—hardwood forest; lake (28).
Fall Creek Falls—256-foot and lesser falls; deep chasms and gorges; virgin forests; Indian artifacts (36).
Harrison Bay—TVA dam forms Chickamauga Lake (43).
Montgomery Bell—upland woods with 2 lakes (22).
Natchez Trace—3 lovely lakes in a state forest (26).
Norris Dam—TVA dam forms Norris Lake; fishing (15).
Paris Landing—on Kentucky Lake; fishing; boating (8).
Pickett—primitive park in Cumberland Mountains near Kentucky; rock formations; caves; lake (4).
Shelby Forest—on bluffs of Mississippi River (40).
Standing Stone—trails in primitive woodlands with cascades and waterfalls; lake with fishing, boating (10).
T. O. Fuller—woods on Mississippi R.; for Negroes (50).
Warriors' Path—Lake Fort Patrick Henry (6).

NATIONAL PARKS AND HISTORICAL PARKS*

Cumberland Gap (Project)—20,000 acres in Tenn., Ky., and Va.; includes famous pass used by Indians, later by Daniel Boone and other pioneers (1).
Great Smoky Mountains—234,192 acres in Tenn. (272,967 acres of park are in N. C.); bluish haze over Appalachian peaks; virgin forest, varied plant life (34).

STATE FORESTS*

Bledsoe (Bledsoe County)—6,656 acres (32).
Cedars of Lebanon (Wilson County)—7,847 acres (20).
Central Peninsula (Campbell and Union Counties)—24,300 acres (19).
Franklin (Franklin & Marion Cos.)—8,240 acres (45).
Grundy (Grundy County)—211 acres (42).
Lewis (Lewis County)—1,257 acres (38).
Madison (Madison County)—38 acres (37).
Morgan (Morgan County)—7,857 acres (18).
Natchez Trace (Henderson, Benton, & Carroll Cos.)—42,610 acres (33).
Pickett (Pickett County)—11,752 acres (5).
Prentice Cooper (Marion & Hamilton Cos.)—25,802 acres (46).
Scott (Scott County)—3,182 acres (11).
Stewart (Stewart County)—4,000 acres (9).

NATIONAL FORESTS*

Cherokee—1,204,102 acres in state; total, 1,204,429 in Tenn. and N. C.; hdqrs., Cleveland (17, 49).

LARGEST CITIES (1950 census)

Memphis (396,000): busy river port; large cotton and lumber market; makes cotton, rubber, paper products.
Nashville (174,307): state capital on Cumberland River; produces cellophane, rayon, metal products, shoes.
Chattanooga (131,041): on Tennessee River; TVA power runs metalworking, textile, woodworking industries.
Knoxville (124,769): industrial city in fertile farm region; marble quarries; cotton textiles; metalworking.
Oak Ridge (30,229): atomic energy research and plants.
Jackson (30,207): railroad shops; wood, textile products.
Johnson City (27,864): textiles; food, wood products.
Kingsport (19,571): chemical and wood products; books.
Bristol, Tenn. (16,771), and **Bristol**, Va. (15,954): state line bisects business district; textiles.

*Numbers in parentheses are keyed to map.

Tennessee Fact Summary

THE PEOPLE BUILD THEIR STATE

1541—Hernando de Soto, on expedition from Florida, probably camps near present Memphis.

1606—Charter to Virginia Company includes Tennessee area in Virginia; charter is first English claim to region.

1665—Charter to Carolina Company repeats English claim to what is now Tennessee.

1673—Louis Joliet and Father Jacques Marquette visit Indians north of site of Memphis. James Needham and Gabriel Arthur explore possibilities of trade in what is now Tennessee.

1682—René Robert Cavelier, Sieur de La Salle explores Mississippi River; claims Mississippi Valley for France, naming it Louisiana; he builds Fort Prud'homme on site of Memphis.

1714—Charles Charleville, French trader, opens trading post at French Lick, near present Nashville.

1730—Split of Carolina into North and South provinces leaves Tennessee part of North Carolina.

1740—French build Fort Assumption on site of Memphis as base against Chickasaw Indians.

1748—Thomas Walker, sent by Loyal Land Company of Virginia, reaches present site of Kingsport.

1756—Construction of Fort Loudoun, first Anglo-American fort in Tennessee, begun; completed, 1757; abandoned to Cherokee Indians, 1760.

1758—Presbyterian mission established at Fort Loudoun.

1760—Daniel Boone explores eastern Tennessee.

1761—Cherokees surrender Fort Loudoun to British.

1763—French cede to British all lands east of Mississippi River.

1769—William Bean, believed to have been first permanent white settler in Tennessee, builds cabin near Watauga River.

1772—Settlers form Watauga Association, one of earliest independent governments west of Appalachians.

1775—Transylvania Land Company buys Cherokee lands in Watauga Territory and resells it to settlers. Watauga Association becomes Washington District.

1776—Washington District, by request of settlers, is annexed to North Carolina; becomes Washington County, 1777, with boundaries of present state of Tennessee.

1777—Cherokees by treaty cede large areas of their land in Tennessee to Virginia and North Carolina.

1779—Jonesboro, first town in Tennessee and seat of Washington County, is chartered. Transylvania Company founds present Nashville.

1780—Tennessee soldiers led by Isaac Shelby and John Sevier help defeat British at battle of Kings Mountain.

1782—Rev. Samuel Doak's school chartered as Martin Academy; believed to be first institution of higher learning in Mississippi Valley.

1784—North Carolina cedes western lands to federal government; settlers in west meet at Jonesboro and organize State of Franklin; North Carolina repeals act to cede the land. State of Franklin collapses, 1788.

1785—U. S. makes treaty with Cherokee Indians recognizing their land titles in Tennessee; similar treaty made with Chickasaws, 1786.

1786—Davy Crockett born in what is now eastern Tennessee; later becomes famous scout, Indian fighter, state legislator, and congressman.

1790—North Carolina again cedes western lands to U. S.; Congress organizes "Territory South of the River Ohio"; governor, William Blount; capital, Rogersville. Knoxville selected as capital site, 1792.

1791—Cherokees surrender more Tennessee land, July 2.

1796—Tennessee admitted to Union, June 1, as 16th state; capital, Knoxville; governor, John Sevier. First congressman elected is Andrew Jackson.

1807—Bank of Nashville, first bank in state, chartered.

1812—Tennessee militia under Gen. Andrew Jackson, defeat Creeks at battle of Tohopeka.

1814—First coal mined in Roane County.

1815—Gen. Andrew Jackson leads Tennessee troops in defense of New Orleans against the British; becomes national hero; elected 7th president of U.S., 1828.

1818—U. S. buys from Chickasaw Indians what is now western Tennessee; land opened to settlers, 1819.

1819—*General Jackson*, first steamboat on Cumberland River, reaches Nashville.

1823—First public school law in state enacted.

1827—Sam Houston elected governor; resigns, 1829.

1834—New state constitution adopted by convention; approved by voters, 1835.

1835—By Treaty of New Echota, Cherokees cede to U. S. all their land east of Mississippi River.

1843—Nashville becomes permanent state capital.

1844—James K. Polk, lawyer from Columbia, elected 11th president of the U. S.

1846—Many Tennesseans respond to troop call for Mexican War; earns state name of "Volunteer State."

1857—Memphis and Charleston Railroad links Tennessee with East coast.

1861—Tennessee is last state to secede from the Union, June 24.

1862—Confederate forts Henry and Donelson surrender; martial law declared; President Lincoln names Andrew Johnson military governor of Tennessee. Battle of Shiloh fought, April 6–7, first of several bloody Civil War battles fought in the state; others were Murfreesboro (Stone River), Dec. 31, 1862–Jan. 2, 1863; Chattanooga and Lookout Mountain, Nov. 23–25, 1863; Franklin, Nov. 30, 1864; and Nashville, Dec. 15–16, 1864.

1865—Tennessee frees its slaves by amending its constitution. Andrew Johnson resigns as governor to become vice-president of U. S.; in April he becomes 17th president of U. S.

1866—Tennessee is first Southern state readmitted to Union, July 24. Fisk University, one of first for Negroes, opened at Nashville.

1870—Third state constitution adopted.

1878—Yellow fever epidemic devastates Memphis.

1879—Legislature designates East Tennessee College at Knoxville as University of Tennessee.

1892—Bridge over Mississippi River opened at Memphis.

1917—Alvin C. York, born in Fentress County, becomes outstanding national hero of World War I.

1923—State government reorganized.

1933—Congress establishes Tennessee Valley Authority (TVA), for irrigation, flood control, and development of new industries, August 31.

1943—Work on atomic energy project begun at Oak Ridge, town specially built to house workers.

1948—TVA-built town of Norris sold to private company.

1949—Camp Forrest, near Tullahoma, chosen by Air Force for Air Engineering Development Center.

1951—State abolishes poll tax.

1953—Constitution, 83 years old, amended for first time.

TENNESSEE

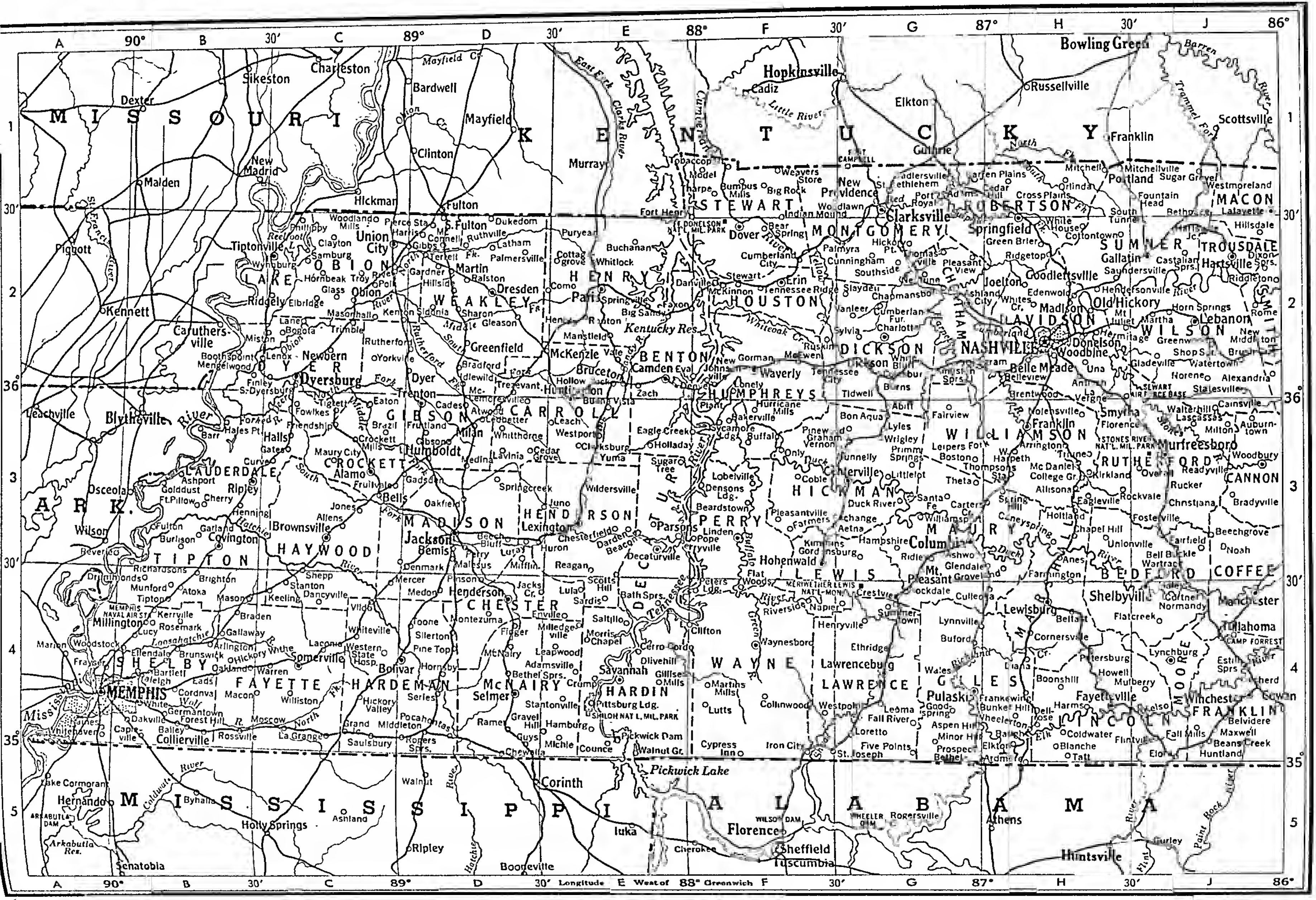
COUNTIES

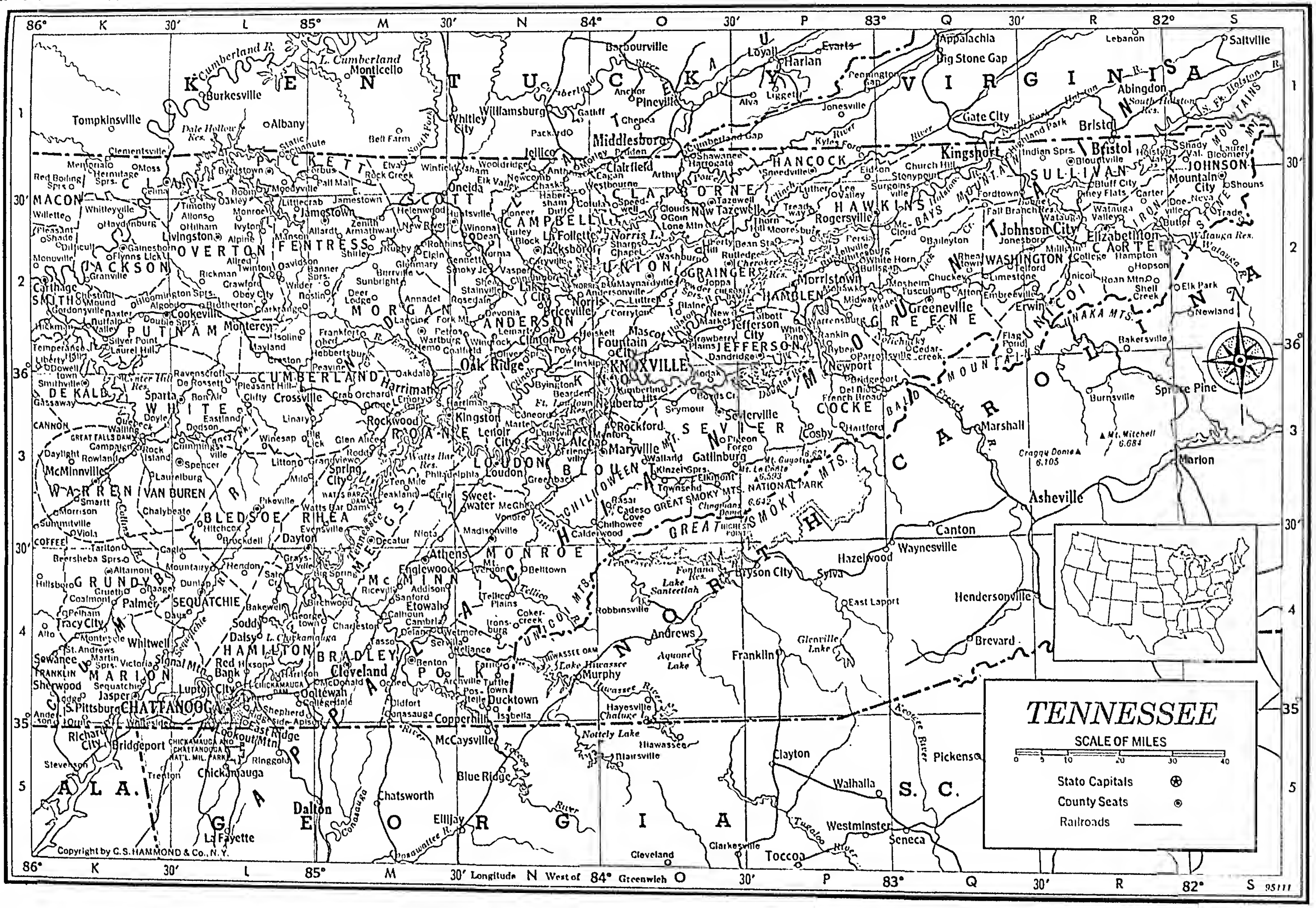
Anderson	59,407	N 2
Bedford	23,627	J 3
Benton	11,495	E 2
Bledsoe	8,561	L 3
Blount	54,691	O 3
Bradley	32,338	M 4
Campbell	34,369	N 2
Cannon	9,174	J 3
Carroll	26,553	E 3
Carter	42,432	R 2
Cheatham	9,167	G 2
Chester	11,149	D 4
Claiborne	24,788	O 2
Clay	8,701	K 1
Cocke	22,991	P 3
Coffee	23,049	J 3
Crockett	16,624	C 3
Cumherland	18,877	M 3
Davidson	321,758	H 2
De Kalb	11,680	K 3
Decatur	9,442	E 3
Dickson	18,805	G 2
Dyer	33,473	C 2
Fayette	27,535	C 4
Fentress	14,917	M 2
Franklin	25,431	J 4
Gibson	48,132	D 3
Giles	26,961	G 4
Grainger	13,086	O 2
Greene	41,048	Q 2
Grundy	12,558	K 4
Hamblen	23,976	P 2
Hamilton	208,255	L 4
Hancock	9,116	P 1
Hardeman	23,311	C 4
Hardin	16,908	E 4
Hawkins	30,494	P 2
Haywood	26,212	C 3
Henderson	17,173	E 3
Henry	23,828	E 2
Hickman	13,353	G 3
Houston	5,318	F 2
Humphreys	11,030	F 2
Jackson	12,348	K 2
Jefferson	19,667	P 2
Johnson	12,278	S 2
Knox	223,007	O 3
Lake	11,655	B 2
Lauderdale	25,047	B 3
Lawrence	28,818	G 4
Lewis	6,078	F 3
Lincoln	25,624	H 4
Loudon	23,182	N 3
Macon	13,599	J 1
Madison	60,128	D 3
Marion	20,520	K 4
Marshall	17,768	H 4
Maury	40,368	G 3
McMinn	32,024	M 4
McNairy	20,390	D 4
Meigs	6,080	M 3
Monroe	24,513	N 4
Montgomery	44,186	G 2
Moore	3,948	J 4
Morgan	15,727	M 2
Obion	29,056	C 2
Overton	17,566	L 2
Perry	6,462	F 3
Pickett	5,093	M 1
Polk	14,074	N 4
Putnam	29,869	K 2
Rhea	16,041	M 3
Roane	31,665	M 3
Robertson	27,024	H 1
Rutherford	40,696	J 3
Scott	17,362	M 2
Sequatchie	5,685	L 4
Sevier	23,375	O 3
Shelby	482,393	B 4
Smith	14,098	K 2
Stewart	9,175	F 1
Sullivan	95,063	R 1
Sumner	33,533	J 2
Tipton	29,782	B 3
Trousdale	5,520	J 2
Unicoi	15,886	R 2
Union	8,670	O 2
Van Buren	3,985	L 3
Warren	22,271	K 3
Washington	59,971	Q 2
Wayne	13,864	F 4
Weakley	27,962	D 2
White	16,204	L 3
Williamson	24,307	H 3
Wilson	26,318	J 2

CITIES AND TOWNS

Ahiff	12	G 3
Adams	525	G 1
Adamsville	927	E 4
Addison	40	M 4
Actna	100	G 3
Afton	150	Q 2
Alamo	1,501	C 3
Alcoa	6,355	N 3
Alexandria	372	J 2
Algood	729	K 2
Allardt	800	M 2
Allens		C 3
Allisona	75	H 3
Allons	270	L 2
Allred	300	L 2
Alpine	200	L 2
Altamont	296	K 4
Alto	125	K 4
Anderson	375	K 4
Andersonville	525	O 2
Anes	35	H 3
Annadel	25	M 2
Anthras	100	N 1
Antioch	298	H 2
Apison		L 5
Archville	150	N 4
Ardmore	157	H 4
Arlington	463	B 4
Armathwaite	350	M 2
Arrington	250	H 3
Arthur	450	O 1
Ashland City	1,024	G 2
Ashport		B 3
Ashwood	80	G 3
Aspen Hill	225	G 4
Athens	8,618	M 4
Atoka	334	B 4
Atwood	1,000	D 3
Auhurntown	273	J 3
Bailey	207	B 4
Baileyton	224	Q 2
Bakerville	68	F 3
Bakewell	250	L 4
Banner Sprs.	406	M 2
Barr	100	B 3
Barren Plains	100	H 1
Bartlett	489	B 4
Bath Springs	50	E 4
Baugh	25	H 4
Baxter	861	K 2
Beacon	200	E 3
Bean Station		P 2
Beans Creek	50	J 4
Bear Spring	100	F 2
Bearden	1,600	N 3
Beardstown	100	F 3
Beech Bluff	180	D 3
Beechgrove	250	J 3
Beersheba Springs	300	K 4
Belfast	150	H 4
Bell Buckle	341	J 3
Belle Meade	2,831	H 2
Belleview	250	H 2
Bells	1,225	C 3
Belltown	100	N 4
Belvidere	250	J 4
Bemis	3,248	D 3
Benton	650	M 4
Berry Hill	1,248	*H 2
Bethel	150	G 4
Bethel Springs	623	D 4
Bethpage	280	J 1
Big Lick	150	L 3
Big Rock	250	F 1
Big Sandy	621	E 2
Big Spring	68	M 4
Birchwood	800	M 4
Blaine	300	O 2
Blanche	250	H 4
Block	160	N 2
Bloomington Springs	200	K 2
Blountville	500	R 1
Bluff City	1,074	R 2
Bogota	300	C 2
Bolivar	2,429	C 4
Bon Air	300	L 3
Bon Aqua	120	G 3
Boom	121	L 1
Boonshill	35	H 4
Boothspolnt	200	B 2
Boston	100	G 3
Boyds Creek	485	O 3
Braden	250	B 4
Bradford	599	D 2
Bradyville	98	J 3
Brazil	140	C 3
Brentwood		H 2
Briccville	2,500	N 2
Bridgeport		P 3
Brighton	306	B 4
Bristol	16,771	R 1
Brockdell		L 3
Brotherton	600	L 2
Brownsville	4,711	C 3
Bruceton	1,204	E 2
Brunswick	500	B 4
Brush Creek	200	J 2
Buchanan	100	E 2
Buena Vista	60	E 3
Buffalo	25	F 3
Buffalo Valley	300	K 2
Buford		G 4
Bullsgap	558	P 2
Bumpus Mills	225	F 1
Bunker Hill	100	H 4
Burlison	75	B 3
Burns		G 2
Burrville	230	M 2
Butler		S 2
Byhee	250	P 2
Byington	125	N 3
Byrdstown	379	L 1
Cades	68	D 3
Cades Cove	40	O 3
Cagle	165	L 4
Cainsvillo		J 3
Calderwood	245	N 3
Calhoun	450	M 4
Camhria	100	M 4
Camden	2,029	E 2
Campaign	100	K 3
Caneyspring	55	H 3
Capleville	950	B 4
Carter	600	R 2
Carters Creek	250	G 3
Carthage	1,604	K 2
Caryville	1,234	N 2
Castalian Sprs.	129	J 2
Cedar Grove	25	D 3
Cedar Hill	872	H 1
Cedarcreek	175	Q 2
Celina	1,136	K 1
Centerville	1,532	G 3
Cerro Gordo	10	E 4
Chalybeate		K 3
Chanute	450	L 1
Chapel Hill	603	H 3
Chapmanshoro	26	G 2
Charleston		M 4
Charlotte	478	G 2
Chaska	121	N 1
Chattanooga	131,041	K 4
Cherry		B 3
Chesterfield	150	E 3
Chestnut Mound	150	K 2
Chewalla	150	D 4
Chilhowee	150	O 3
Christiana	300	J 3
Chuckey	300	Q 2
Church Hill	1,741	Q 1
Clairfield	2,000	O 1
Clarkrange		L 2
Clarksburg	350	E 3
Clarksville	16,246	G 1
Clayton	30	C 2
Clementsville	25	K 1
Cleveland	12,605	M 4
Clifton	818	F 4
Clifty	51	L 3
Clinchmore		N 2
Clinton	3,712	N 2
Clouds	50	O 2
Coalfield		M 2
Coalmont	800	K 4
Cohle	100	F 3
Cokercreek	366	N 4
Coldwater	85	H 4
Coleshurg	150	G 2
College Grove	300	H 3
Collegedale	1,200	M 4
Collierville	1,153	B 4
Collinwood	589	F 4
Columbia	10,911	G 3
Como	120	E 2
Conasauga	475	M 4
Concord	294	N 3
Cookeville	6,924	L 2
Copperhill	924	N 4
Cordova	250	B 4
Cornersville	358	H 4
Corryton	1,275	O 2
Cortner	63	J 4
Cosby		P 3
Cottagegrove	126	E 2
Cottontown	250	H 2
Cotula	250	O 2
Counce		E 4
Covington	4,379	B 3
Cowan	1,835	J 4
Crab Orchard	315	M 3
Crawford	100	L 2
Creston	125	L 2
Crestview	356	G 4
Crockett Mills	148	C 3
Cross Plains	200	H 1
Crossville	2,291	L 3
Crump	500	E 4
Culleoka	300	G 4
Cumberland City	500	F 2
Cumherland Furnace	350	G 2
Cumherland Gap	403	O 1
Cummingsville	50	L 3
Cunningham	250	G 2
Curve		B 3
Cypress Inn	1,000	F 4
Daisy	1,336	L 4
Dale Hollow	5	*K 1
Dancyville	80	C 4
Dandridge	690	O 2
Danville		F 2
Darden	250	E 3
Daus		L 4
Davidson		L 2
Daylight	250	K 3
Dayton	3,191	L 3
De Rossett	250	L 3
Dean	130	N 2
Decatur	235	M 3
Decaturville	514	E 3
Decherd	1,435	J 4
Deer Lodge	275	M 2
Del Rio	300	P 3
Delano	350	M 4
Dellrose	350	H 4
Denmark	69	D 3
Densons Landing		F 3
Denver	130	F 2
Devonia	250	N 2
Diana		H 4
Dickson	3,348	G 2
Difficult	500	K 2
Dixon Springs	200	J 2
Dodson	98	L 3
Doeville	125	S 2
Donelson	1,765	H 2
Double Sprs.	200	K 2
Dover	800	F 2
Dowelltown	262	K 2
Doyle	500	K 3
Dresden	1,509	D 2
Drummonds	160	A 4
Duck River		G 3
Ducktown	1,064	N 4
Duff		N 2
Dukedom	115	D 2
Dunlap	873	L 4
Dyer	1,864	D 2
Dyersburg	10,885	C 2
Eads	250	B 4
Eagan	300	O 1
Eagle Creek		E 3
Eagleville	378	H 3
E. Jamestown	100	M 2
East Ridge	9,645	L 5
Eastland		L 3
Eaton		C 3
Edenwold	500	H 2
Eidson	300	P 1
Elbridge	89	C 2
Elgin	350	M 2
Elizabethton	10,754	R 2
Elk Valley	300	N 1
Elkmont	35	O 3
Elkton	168	H 4
Ellendale	700	B 4
Elora	225	J 4
Elva	15	M 1
Emhreeville	1,273	Q 2
Emory Gap	350	M 3
Englewood	1,545	M 4
Enville	350	E 4
Erie	25	M 3
Erin	858	F 2
Erwin	3,387	R 2
Estill Springs	496	J 4
Ethridge	500	G 4
Etowah	3,261	M 4
Eva	250	E 2
Evensville	450	M 3
Fairfield	100	J 3
Fairview		G 3
Fall Branch	300	Q 2
Fall Mills	34	J 4
Fall River	50	G 4
Farmers Exchange	134	F 3
Farmington	200	H 3
Farner	200	N 4
Faxon	120	E 2
Fayetteville	5,447	H 4
Finger	130	D 4
Finley	1,000	B 2
Five Points	125	G 4
Flag Pond	300	Q 2
Flat Woods	275	F 4
Flatcreek		J 4
Flintville	300	J 4
Florence	125	H 3
Flynns Lick	50	K 2
Forbus	200	M 1
Fordtown		Q 2
Forest Hill	200	B 4
Fork Mountain	900	N 2
Fort Henry	10	E 1
Fort Pillow	150	B 3
Fosterville	200	J 3
Fountain City	15,000	O 2
Fountain Head	252	J 1
Fowlkes	150	C 3
Frankewing	90	H 4
Frankfort		M 2
Franklin	5,475	H 3
Frayser		A 4
French Broad	154	P 3
Friendship	452	C 3
Friendsville	625	N 3
Fruitland		D 3
Fruitvale	50	C 3
Fulton	150	B 3
Gadsden	255	D 3
Gainesboro	992	K 2
Gallatin	5,107	H 2
Gallaway	200	B 4
Gardner		D 2
Garland	157	B 3
Gassaway	80	K 3
Gates	234	C 3
Gatlinburg	1,301	O 3
Gennett	25	N 2
Georgetown	100	L 4
Germantown	408	B 4
Gibhs	100	D 2
Gibson	308	D 3
Gillises Mills		E 4
Gladeville	114	J 2
Glass	75	C 2
Gleason	1,063	D 2
Glen Alice	300	M 3
Glendale	130	G 3
Glenmary	300	M 2
Goin	300	O 2
Golddust	50	B 3
Goodlettsville	1,590	H 2
Goodspring	31	G 4
Gordonsburg		F 3
Gordonsville	304	K 2
Gorman	80	F 2
Graham	25	G 3
Grand Jct.	477	C 4
Grandview	250	M 3
Granville	130	K 2
Gravel Hill	42	D 4
Graysville	820	L 4
Green Brier	890	H 2
Greenback	1,200	N 3
Greeneville	8,721	Q 2
Greenfield	1,706	D 2
Greenwood	200	J 2
Groveland	25	G 3
Gruetli	600	K 4
Guys	100	D 4
Habersham	500	N 2
Hales Point	25	B 3
Haley	150	J 4
Halls	1,808	C 3
Hamhurg	350	E 4
Hampshire	200	G 3
Hampton	1,164	R 2
Harms	75	H 4
Harriman	6,389	M 3
Harris	75	C 2
Harrison	500	L 4
Harrogate		O 1
Hartford	200	P 3
Hartsville	1,130	J 2
Hartsville Jct.	40	J 2
Haydenhurg	100	K 2
Hehhertshurg	110	M 2
Heiskell	130	O 2
Helenwood	500	M 2
Henderson	2,532	D 4
Hendersonville	1,000	J 2
Hendon	125	L 4
Henning	493	B 3
Henry	200	E 2
Henryville	150	G 4
Hermitage	800	H 2
Hermitage Springs	200	K 1
Hickman	175	K 2
Hickory Point	100	G 2
Hickory Valley	400	C 4
Hickory Withe	50	C 4
Highland Pk.	3,500	R 1
Hilham	177	L 2
Hillshoro	200	K 4
Hillsdale		J 2
Hillside	160	D 2
Hitchcox	98	L 3
Hixson	2,100	L 4
Hohenwald	1,703	F 3
Holladay	200	E 3
Hollow Rock	397	E 2
Holston Valley	125	R 1
Holtland	400	H 3
Hopson	300	R 2
Horn Springs	200	J 2
Hornbeak	309	C 2

*No room on map for name.


MISSOURI
KENTUCKY
ARK.
MISSISSIPPI
ALABAMA
Bowling Green
Hopkinsville
Russellville
Scottsville
Sikeston
Charleston
Dexter
Malden
New Madrid
Kennett
Caruthersville
Blytheville
Osceola
Piggott
Mayfield
Murray
Hickman
Fulton
Union City
OBION
LAKE
DYER
Dyersburg
WEAKLEY
Dresden
Martin
HENRY
Paris
STEWART
Dover
MONTGOMERY
Clarksville
ROBERTSON
Springfield
SUMNER
Gallatin
MACON
TROUSDALE
Hartsville
SMITH
WILSON
Lebanon
DAVIDSON
NASHVILLE
CHEATHAM
DICKSON
HOUSTON
Erin
HUMPHREYS
Waverly
BENTON
Camden
CARROLL
Huntingdon
GIBSON
Trenton
Humboldt
Milan
CROCKETT
Alamo
LAUDERDALE
Ripley
TIPTON
Covington
HAYWOOD
Brownsville
MADISON
Jackson
HENDERSON
Lexington
DECATUR
Decaturville
PERRY
Linden
HICKMAN
Centerville
WILLIAMSON
Franklin
RUTHERFORD
Murfreesboro
CANNON
Woodbury
MAURY
Columbia
LEWIS
Hohenwald
BEDFORD
Shelbyville
COFFEE
Manchester
Tullahoma
MARSHALL
Lewisburg
GILES
Pulaski
LINCOLN
Fayetteville
MOORE
Lynchburg
FRANKLIN
Winchester
LAWRENCE
Lawrenceburg
WAYNE
Waynesboro
HARDIN
Savannah
McNAIRY
Selmer
CHESTER
Henderson
HARDEMAN
Bolivar
FAYETTE
Somerville
SHELBY
MEMPHIS
Millington
Collierville
Kentucky Res.
Pickwick Lake
Corinth
Holly Springs
Florence
Sheffield
Tuscumbia
Athens
Huntsville
Iuka
Booneville
Senatobia
Hernando
Longitude West of 88° Greenwich


TENNESSEE
SCALE OF MILES
0 5 10 20 30 40
State Capitals
County Seats
Railroads
KENTUCKY
VIRGINIA
NORTH CAROLINA
GEORGIA
ALA.
S. C.
KNOXVILLE
CHATTANOOGA
Kingsport
Bristol
Johnson City
Asheville
Oak Ridge
GREAT SMOKY MTS. NATIONAL PARK
Longitude West of Greenwich
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Hornsby	280	D 4
Howell	150	H 4
Humboldt	7,426	D 3
Huntingdon	2,043	E 2
Huntland	285	J 4
Huntsville	1,400	N 2
Huron	70	E 3
Hurricane Mills	35	F 3
Idlewild	200	D 2
Indian Mound	375	F 1
Indian Springs	300	R 1
Inskip	5,000	N 2
Iron City	750	F 4
Ironsburg	100	N 4
Isabella	400	N 4
Isham	75	N 1
Isoline	275	L 2
Ivyton		L 2
Jacks Creek	75	D 4
Jacksboro	1,500	N 2
Jackson	30,207	D 3
Jamestown	2,115	M 2
Jasper	1,198	K 4
Jefferson City	3,633	P 2
Jellico	1,556	N 1
Joelton	2,500	H 2
Johnson City	27,864	R 2
Jones	140	C 3
Jonesboro	1,126	Q 2
Joppa	85	O 2
Juno	80	E 3
Keeling	100	C 4
Kelso	85	J 4
Kenton	899	C 2
Kerrville	300	B 4
Kimberlin Hts.	120	O 3
Kimmins	78	F 3
Kingsport	19,571	Q 1
Kingston	1,627	N 3
Kingston Springs	390	G 2
Kinzel Springs	100	O 3
Kirkland	225	H 3
Knoxville	124,769	O 3
Kodak	1,670	O 3
Kyles Ford	75	P 1
La Follette	5,797	N 2
La Grange	241	C 4
La Vergne	500	H 2
Laager	650	K 4
Laconia	75	C 4
Lafayette	1,195	J 1
Lake City	1,827	N 2
Lancing	250	M 2
Lane	150	C 2
Lascassas	250	J 3
Latham	85	D 2
Laurel Bloomery	208	S 1
Laurel Hill		K 2
Laurelburg		L 3
Lavinia	88	D 3
Lawrenceburg	5,442	G 4
Leach	15	E 3
Leapwood	110	E 4
Lebanon	7,913	J 2
Ledbetter	25	D 3
Lee Valley	200	P 2
Leinarts	32	N 2
Leipers Fork	325	G 3
Lenoir City	5,159	N 3
Lenox	500	C 2
Leoma	398	G 4
Lewisburg	5,164	H 4
Lexington	3,566	E 3
Liberty	314	K 2
Liberty Hill		O 2
Limestone	450	Q 2
Linary	160	L 3
Linden	854	F 3
Littlecrab	100	L 2
Littlelot	150	G 3
Litton	25	L 3
Livingston	2,082	L 2
Lobelville	600	F 3
Lodge		K 4
Lone Mtn.	175	O 2
Lonely	76	F 2
Lookout Mountain	1,675	L 5
Loretto	706	G 4
Loudon	3,567	N 3
Louisville	130	N 3
Lucy	600	B 4
Lula		E 4
Lupton City	1,250	L 4
Luray	300	D 3
Luther		P 2
Luttrell	382	O 2
Lutts	250	F 4
Lyles	500	G 3
Lynchburg	401	J 4
Lynnville	356	G 4
Macon	215	B 4
Madison	7,000	H 2
Madisonville	1,487	N 3
Malesus	500	D 3
Manchester	2,341	J 4
Mansfield	110	E 2
Manson		L 2
Martel	95	N 3
Martha	25	J 2
Martin	4,082	D 2
Martin Sprs.	200	K 4
Martins Mills	33	F 4
Maryville	7,742	O 3
Mascot	2,500	O 2
Mason	414	B 4
Masonhall	175	C 2
Maury City	553	C 3
Maxwell	85	J 4
Mayland	175	L 2
Maynardville		O 2
McCloud	100	Q 2
McConnell		D 2
McDaniel	100	H 3
McDonald	150	M 4
McEwen	710	F 2
McGhee	75	N 3
McKenzie	3,774	E 2
McKinnon	250	F 2
McLemoresville	242	D 3
McMinnville	7,577	K 3
McNairy	90	D 4
Medina	690	D 3
Medon	115	D 4
Memorial	300	K 1
Memphis	396,000	B 4
Mengelwood	200	B 2
Mentor	425	O 3
Mercer	400	D 4
Michie		E 4
Middleton	362	D 4
Midway	200	P 2
Mifflin	250	D 3
Milan	4,938	D 3
Milledgeville	300	E 4
Milligan College	213	R 2
Millington	4,696	B 4
Milo	300	L 3
Milton	75	J 3
Minor Hill	292	G 4
Miston	350	B 2
Mitchell		H 1
Mitchellville	202	J 1
Model	140	F 1
Mohawk	200	P 2
Monoville	75	K 2
Monroe		L 2
Monteagle	865	K 4
Monterey	2,043	L 2
Montezuma	130	D 4
Moodyville	400	L 1
Mooresburg	500	P 2
Morley	300	O 1
Morris Chapel		E 4
Morrison	301	K 3
Morristown	13,019	P 2
Moscow	394	C 4
Mosheim	350	Q 2
Moss	200	K 1
Mt. Juliet		H 2
Mt. Pleasant	2,931	G 3
Mt. Vernon	250	N 4
Mtn. City	1,405	S 2
Mountairy	140	L 4
Mulberry	220	H 4
Munford	976	B 4
Murfreesboro	13,052	J 3
Napier	75	F 4
NASHVILLE	174,307	H2
Nemo	8	M 2
Neptune	125	G 2
Neubert	2,800	O 3
Neva	50	S 2
New Johnsonville	100	F 2
New Market	600	O 2
New Middleton	150	J 2
New Providence	1,825	G 1
New River	650	M 2
New Tazewell	1,400	O 2
Newbern	1,734	C 2
Newcomb		N 1
Newport	3,892	P 3
Niota	956	M 3
Noah	100	J 3
Nolensville		H 3
Norene	250	J 2
Norma		N 2
Normandy	159	J 4
Norris	1,134	N 2
Nunnelly		G 3
Oak Ridge	30,229	N 2
Oakdale	718	M 3
Oakfield	125	D 3
Oakland	236	B 4
Oakley	50	L 2
Oakville	1,500	A 4
Obey City		L 2
Obion	1,212	C 2
Ocoee	225	M 4
Old Hickory	10,000	H 2
Oldfort	133	M 4
Olivehill	140	E 4
Oliver Sprs.	1,089	N 2
Oneida	1,304	N 1
Only		F 3
Ooltewah	900	M 4
Orlinda	275	H 1
Orme	230	K 4
Overall	135	J 3
Ozone	140	M 3
Pall Mall	100	M 1
Palmer	871	K 4
Palmersville	100	D 2
Palmyra	200	G 2
Paris	8,826	E 2
Parrottsville	115	P 2
Parsons	1,640	E 3
Peakland		M 3
Peavine	35	M 2
Pegram	325	H 2
Pelham	325	K 4
Perry	100	D 3
Perryville	150	F 3
Persia	50	P 2
Peters Landing	40	F 4
Petersburg	497	H 4
Petros	800	M 2
Philadelphia	600	M 3
Phillippy	375	C 2
Pickwick Dam	250	E 4
Pierce Station	50	C 2
Pigeon Forge	1,500	O 3
Pikeville	882	L 3
Pine Top	15	D 4
Pinewood	5	F 3
Piney Flats	300	R 2
Pinson	300	D 4
Pioneer		N 2
Pittsburg Landing	114	E 4
Plant	250	F 3
Pleasant Hill	152	L 3
Pleasant Shade	125	K 2
Pleasant View	300	G 2
Pleasantville		F 3
Pocahontas	250	D 4
Polk	50	C 2
Pope	30	F 3
Port Royal		G 1
Portland	1,660	H 1
Postelle	232	N 4
Powder Sprs.	110	O 2
Powell	400	N 2
Primm Springs	4	G 3
Prospect	350	G 4
Pruden	250	O 1
Pulaski	5,762	G 4
Puryear	430	E 2
Quebeck	200	K 3
Rader	72	Q 2
Raines	2,000	A 4
Raleigh	1,100	B 4
Ralston	78	D 2
Ramer	400	D 4
Rankin		P 2
Rasar	200	O 3
Ravenscroft	96	L 3
Readyville	250	J 3
Reagan	250	E 3
Red Bank		L 4
Red Boiling Springs	1,000	K 1
Reliance		N 4
Reverie	250	A 3
Rheatown	107	Q 2
Riceville	450	M 4
Richard City	300	K 5
Richardsons	50	B 4
Rickman	500	L 2
Riddleton	150	J 2
Ridgely	1,504	B 2
Ridgeside	337	L 4
Ridgetop	354	H 2
Ridley	150	G 3
Ripley	3,318	B 3
Riverside	80	F 4
Rives	413	C 2
Roan Mountain	1,000	R 2
Robbins	900	M 2
Rock Creek	20	M 1
Rock Island	150	K 3
Rockdale	25	G 4
Rockford	1,500	O 3
Rockvale	139	J 3
Rockwood	4,272	M 3
Roddy	200	M 3
Rogers Springs	100	D 4
Rogersville	2,545	P 2
Rome	125	J 2
Rosedale		N 2
Rosemark	300	B 4
Roslin	300	M 2
Rossville	175	B 4
Routon	150	E 2
Rowland	35	K 3
Rucker	78	J 3
Rugby		M 2
Ruskin	26	F 2
Russellville	608	P 2
Rutherford	994	C 2
Ruthville		D 2
Rutledge	600	P 2
Sadlersville	100	G 1
Saint Andrews		K 4
St. Bethlehem	275	G 1
Saint Joseph	550	G 4
Sale Creek	650	L 4
Saltillo	400	E 4
Samburg	378	C 2
Sanford		M 4
Santa Fe	250	G 3
Sardis	299	E 4
Saulsbury	143	C 4
Saundersville	200	J 2
Savannah	1,698	E 4
Scotts Hill	299	E 4
Selmer	1,759	D 4
Sequatchie		K 4
Serles	50	D 4
Servilla	100	M 4
Sevierville	1,620	P 3
Sewanee	1,407	K 4
Seymour	120	O 3
Shady Valley	2,238	S 1
Sharon	880	D 2
Sharps Chapel	50	O 2
Shawanee	350	O 1
Shea	150	N 2
Shelbyville	9,456	H 4
Shell Creek	200	R 2
Shepherd	1,000	L 4
Shepp		C 4
Sherwood		K 4
Shirley	171	M 2
Shop Spring	150	J 2
Shouns	350	S 2
Sidonia	175	D 2
Signal Mountain	1,786	L 4
Silerton	121	D 4
Silver Point	150	K 2
Slayden	90	G 2
Smartt	300	K 3
Smithville	1,558	K 3
Smoky Jct.	200	N 2
Smyrna	1,544	H 3
Sneedville	500	P 1
Soddy	2,157	L 4
Somerville	1,760	C 4
S. Dyersburg		C 2
South Fulton	2,119	D 2
S. Harriman	2,761	M3
S. Pittsburg	2,573	K 4
South Tunnel	500	H 2
Southside	200	G 2
Sparta	4,299	K 3
Speedwell		O 2
Spencer	721	L 3
Spring City	1,725	M 3
Spring Hill	541	H 3
Springcreek		D 3
Springfield	6,506	H 2
Springville	30	E 2
Stainville	800	N 2
Stanton	503	C 4
Stantonville	300	E 4
Statesville	150	J 2
Static	40	L 1
Stewart		F 2
Stonypoint		Q 1
Strawberry Plains		O 2
Sugar Grove	25	J 1
Sugar Tree		E 3
Summertown	300	G 4
Summitville	400	K 3
Sunbright	600	M 2
Surgoinsville	800	Q 2
Sweetwater	4,199	N 3
Sycamore Landing	53	F 3
Sylvia	186	G 2
Taft	225	H 4
Talbott	250	P 2
Tarlton	75	K 3
Tasso	150	M 4
Tazewell	1,000	P 2
Telford	300	R 2
Tellico Plains	833	N 4
Temperance Hall	100	K 2
Ten Mile		M 3
Tennessee City	180	F 2
Tennessee Ridge	275	F 2
Terrell	70	D 2
Tharpe	30	F 1
Theta	250	G 3
Thomasville	27	G 2
Thompsons Sta.	150	H 3
Thorn Hill	35	P 2
Tidwell	50	G 2
Tigrett	175	C 3
Timothy		L 2
Tipton	35	B 4
Tiptonville	1,953	B 2
Tobaccoport	30	F 1
Toone	231	D 4
Townsend	328	O 3
Tracy City	1,414	K 4
Trade	75	S 2
Treadway		P 2
Trenton	3,868	D 3
Trezevant	765	D 2
Trimble	674	C 2
Triune	225	H 3
Troy	593	C 2
Tullahoma	7,562	J 4
Turley	40	N 2
Turtletown	200	N 4
Tusculum	250	Q 2
Twinton	75	L 2
Tyner	1,000	L 4
Una	500	H 2
Unicoi	1,500	R 2
Union City	7,665	C 2
Unionville	176	H 3
Vale	50	E 2
Vanleer	243	G 2
Vasper		N 2
Vernon	150	F 3
Victoria		K 4
Vildo	75	C 4
Viola	223	K 3
Vonore	478	N 3
Wales	50	G 4
Walland	300	O 3
Walling	200	K 3
Walnut Grove		E 4
Walterhill	200	J 3
Warren	75	C 4
Warrensburg	75	P 2
Wartburg	400	M 2
Wartrace	545	J 3
Washburn	170	O 2
Watauga	500	R 2
Watauga Valley	200	R 2
Watertown	933	J 2
Watts Bar Dam	110	M 3
Waverly	1,892	F 2
Waynesboro	1,147	F 4
Weavers Store		F 1
West Harpeth	30	H 3
Westbourne	600	O 1
Western State Hospital	3,000	C 4
Westmoreland	895	J 1
Westpoint	350	G 4
Westport	175	E 3
Wetmore	125	N 4
Wheelerton	65	H 4
White		B 4
White Bluff	506	G 2
White Horn		Q 2
White House	350	H 2
White Pine	780	P 2
Whitehaven	1,311	A 4
Whites Creek	100	H 2
Whitesburg	500	P 2
Whiteside	500	K 5
Whiteville	794	C 4
Whitleyville	75	K 2
Whitlock	142	E 2
Whitthorne	15	D 3
Whitwell	1,586	K 4
Wilder	300	L 2
Wildersville	275	E 3
Willette	100	K 2
Williamsport	140	G 3
Williston	175	C 4
Winchester	3,974	J 4
Windrock	337	N 2
Winesap	80	L 3
Winfield	350	M 1
Winona		N 2
Woodbine	19,000	H 2
Woodbury	1,000	J 3
Woodland Mills	175	C 2
Woodlawn	35	G 1
Woodstock	300	A 4
Wooldridge		N 1
Wrigley		G 3
Wynnburg	200	C 2
Yorkville	500	C 2
Yuma		E 3
Zach	100	E 2
Zenith	40	M 2

TENNESSEE VALLEY AUTHORITY (TVA). The Tennessee Valley in the southeastern United States is a region of bottom lands, hills, and mountains drained by the Tennessee, a major river of the nation.

The river is the largest tributary of the Ohio and is formed by the joining of the Holston and French Broad rivers near Knoxville, Tenn. Its sources are in the South Appalachian Highlands of Virginia and North Carolina, an area second only to the Pacific Northwest in the amount of annual rainfall.

The valley contains about 41,000 square miles and includes parts of seven states. More than half of it is in Tennessee; the rest is in Alabama, North Carolina, Virginia, Georgia, Mississippi, and Kentucky. About 3½ million people live in the valley.

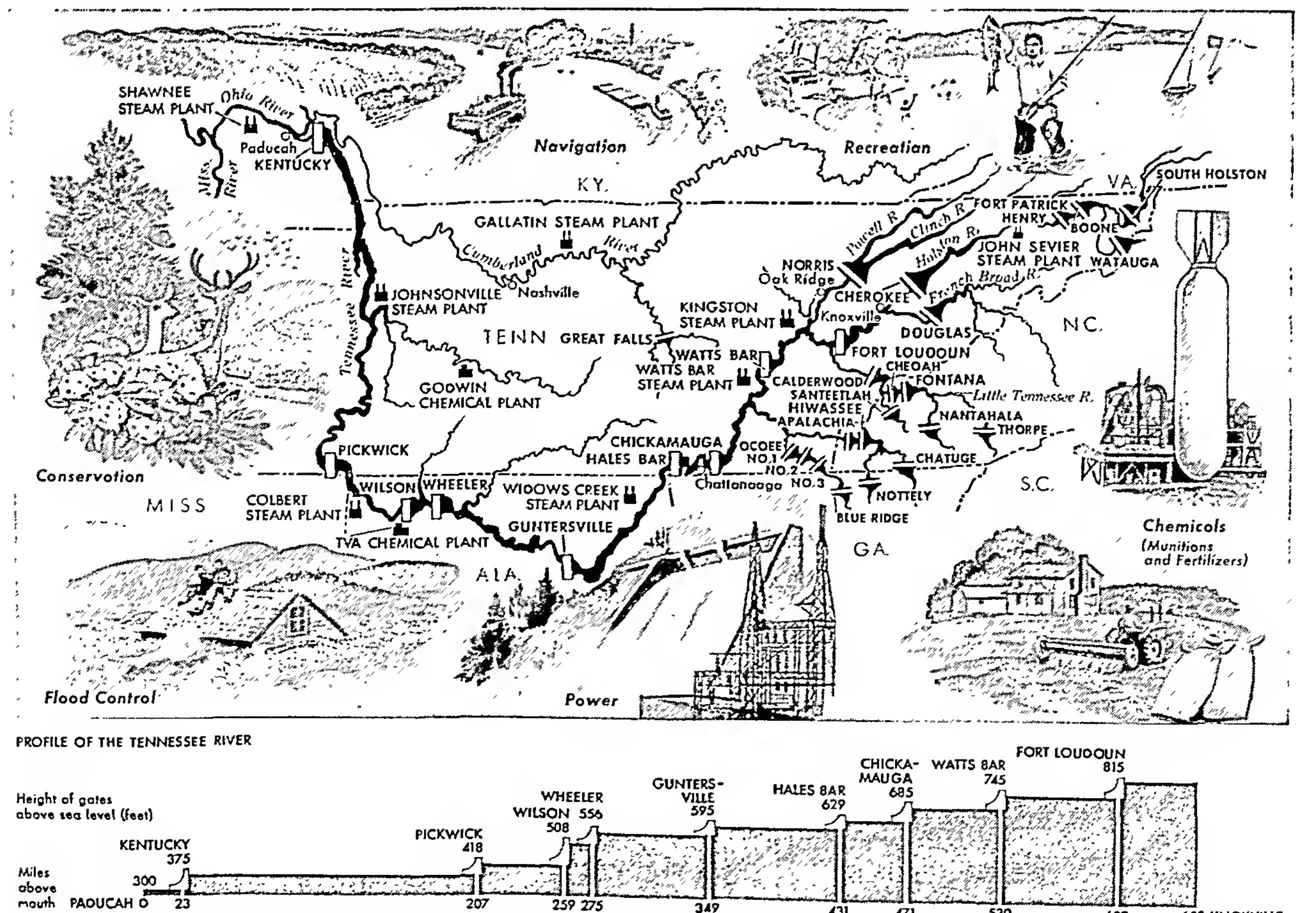
Although the region is rich in resources—water power, coal, phosphates and other minerals, and varied plant life—for many years its farmers did not prosper. In times of heavy rainfall the Tennessee River and its tributaries flooded lowlands and washed away fertile soil. The hillsides and uplands were cleared of protecting forests, and fields were planted with corn, cotton, and tobacco year after year. These crops exhausted the soil and failed to hold it in place as trees and forage crops do. The fields became gullied and eroded by torrential rains that washed the soil into the rivers. As a result, most of the farmers of the valley found it hard to make a living. They lived in overcrowded, unsanitary houses or cabins and lacked proper food and clothing.

In 1933 the federal government chose this "cross-section of America" for an experiment in social and economic planning. The plan was to harness the Tennessee River for power production, flood control, and improvement of navigation. The river was to be made to work for the people of the valley instead of against them. For the first time, the possibilities of a whole river system were to be treated as a unit. Another objective was to obtain some return on the capital which the government had invested in the Wilson Dam and power and nitrate plants at Muscle Shoals, Ala., during World War I.

A corporation, the Tennessee Valley Authority (TVA), was set up to undertake the work. Wide powers were given it, including building of dams, power houses, and transmission lines; manufacture of fertilizers at Muscle Shoals; and sale of electric power at low rates for widespread use. The act directed the Authority to keep complete cost accounts for use of Congress, government agencies, and the public. TVA's costs and rates came to be regarded as a national "yardstick" in the public utility field.

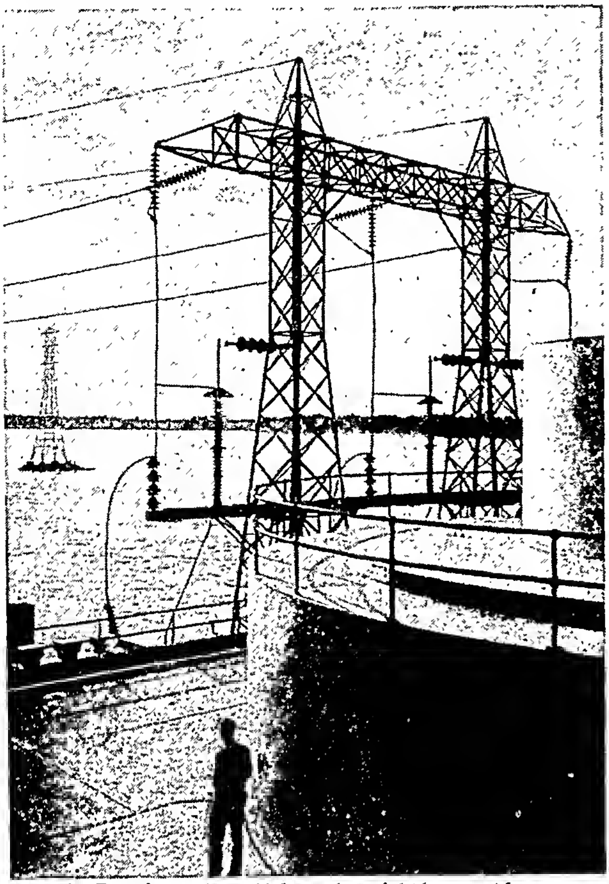
The heart of the project was the construction of a series of line dams on the Tennessee River, between

HARNESSING THE WATERS OF THE TENNESSEE RIVER



The dams of the TVA (top) have tamed the once-wild Tennessee River in its great U-shaped course. The profile view (bottom) shows the nine dams on the main stream which control the 815-foot drop in water level along its 650-mile flow from Knoxville.

HYDROELECTRIC POWER FROM A TVA DAM



Wheeler Dam in northern Alabama has eight huge outdoor generators like the one shown here. At the left is a tower that enables the hydroelectric lines to span the reservoir. Placed in operation in 1936 Wheeler was the second TVA dam to be completed.

Knoxville and Paducah, as shown by the map on the preceding page. Five other large storage dams were built on the chief tributaries—Norris on the Clinch River, Cherokee on the Holston, Douglas on the French Broad, Fontana on the Little Tennessee, and Hiwassee on the Hiwassee. To supplement its project TVA also constructed smaller dams near the headwaters of several tributary streams. In addition it purchased five dams (including Great Falls Dam on the Cumberland River) from a private utility company. It also directs water storage at five private dams.

This system of dams tamed the Tennessee River and its tributaries into a chain of quiet lakes. The gigantic project controlled floods and provided a navigable nine-foot channel from Paducah to Knoxville.

Supreme Court decisions upheld the right of TVA to sell electric power. After heated controversy, major private power companies in the valley sold out to TVA. Thereafter electricity was sold at almost 50 per cent less than the average cost for the nation. After the war in Korea began, TVA speeded work on steam-generating plants for power for national defense. Its chemical plants produce fertilizers and munitions.

Developing the Resources of the Valley

The TVA has brought many other benefits to the people of the Tennessee Valley. Some 70,000 farmers have engaged in a program of test-demonstration farming to improve agriculture. They are taught to use crop diversification and dairying (instead of the one-crop system), fertilizers, crop rotation, and other sound farming methods. These practices raised the standard of living as well as preventing soil erosion. As part of a reforestation program TVA supplied more than 200 million tree seedlings and gave demonstrations in conserving existing woodlands.

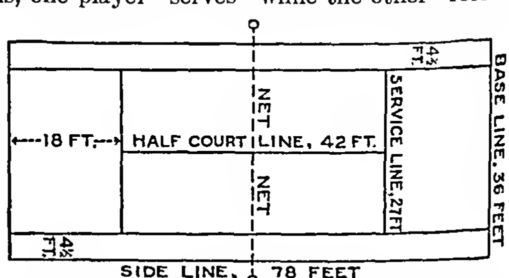
Since 1933, improved navigation and abundant cheap power has attracted more than 2,000 new industrial concerns to the valley. Many of these industries use the natural resources of the region and thus help balance agriculture and manufacturing. Another direct benefit of TVA has been the promotion of a tourist trade by utilizing the vast recreational facilities of the valley. In addition to aiding the economic progress of the region, TVA has aided education by sponsoring vocational training and by establishing libraries now under local administration.

During the second World War TVA supplied electric power to the Oak Ridge atomic energy plant and other war industries. By 1952 more than one million consumers—homes, farms, factories, and the atomic energy plant—were using approximately 18 billion kilowatt-hours of electricity a year. About 145 municipal and rural coöperatives distributed the power.

TENNIS. Lawn tennis is a modern development of an older game of tennis played in a covered court. The present game was first played in England about 1873 and soon after was introduced in the United States.

It is played on a level court of grass, asphalt, concrete or earth. Clay courts are often surfaced with brick dust, stone dust, or special preparations. Markings and dimensions are shown in the diagram below. The 4½-foot side courts are used only for the "doubles" game. The net is 3 feet high at the center and 3½ feet at the posts. The ball is between 2½ and 2⅝ inches in diameter and weighs between 2 and 2 1/16 ounces. Rackets, weighing from 13 to 16 ounces, are usually wooden frames strung with gut or nylon.

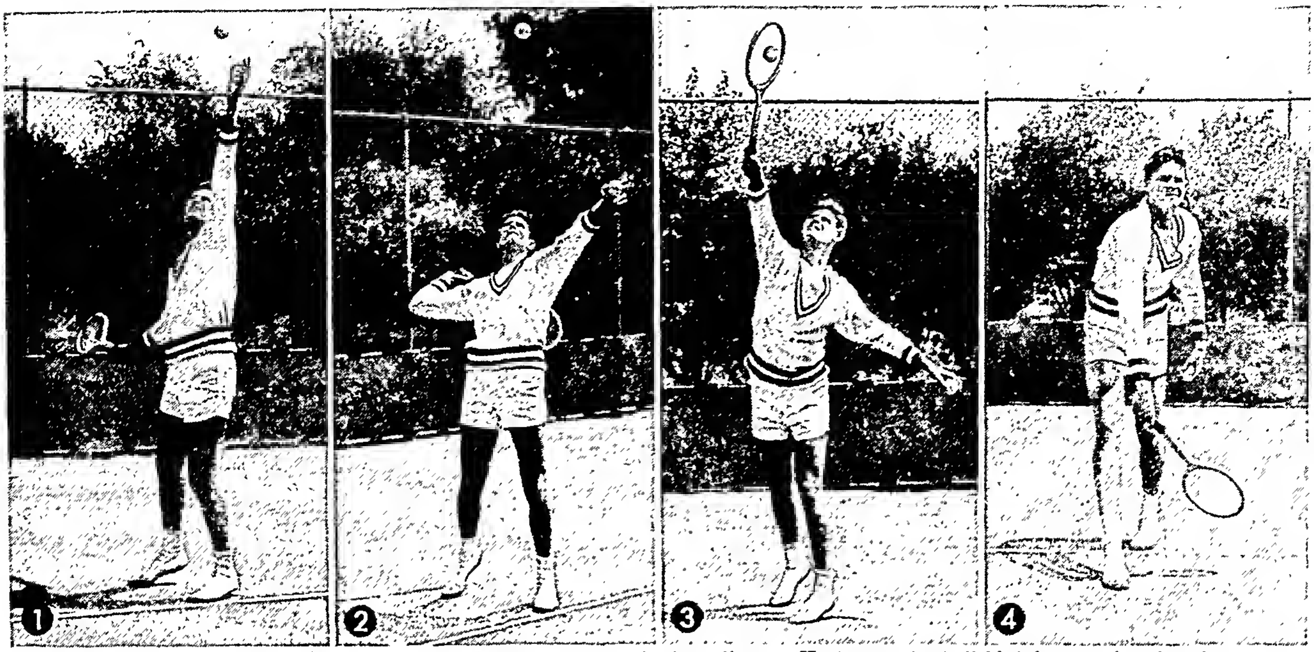
At the start of a "singles" match between two persons, one player "serves" while the other "receives."



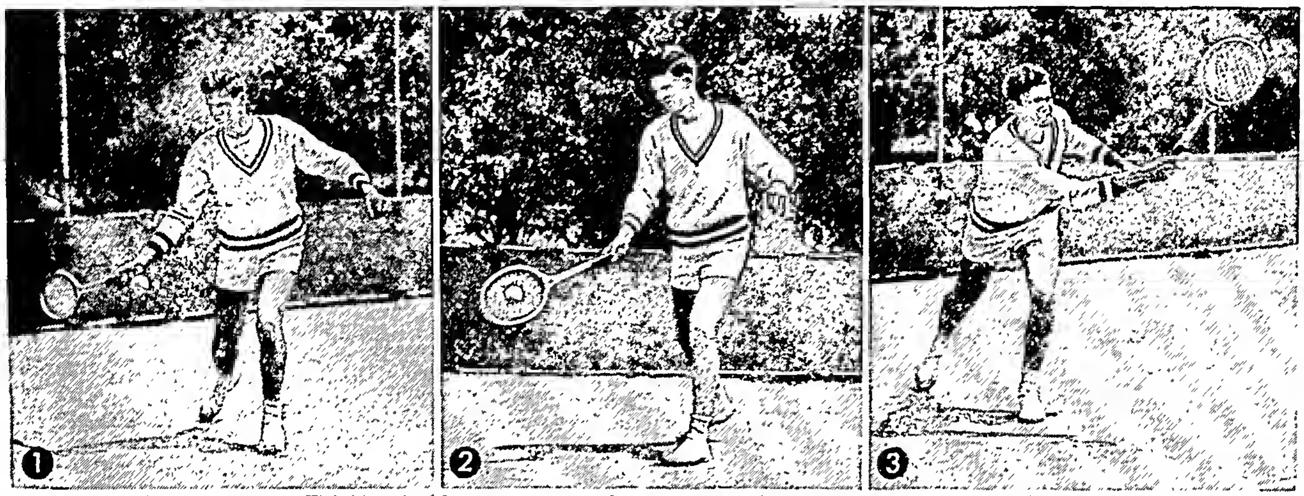
This shows the standard plan and dimensions of a tennis court for both "singles" and "doubles" play.

The server stands behind the base line and strikes the ball over the net into the service court diagonally opposite. If the first ball is a "fault," he may serve another. The receiver must hit the ball on the first bound, trying to drive it back over the net so that it will fall within the court. If he fails to return

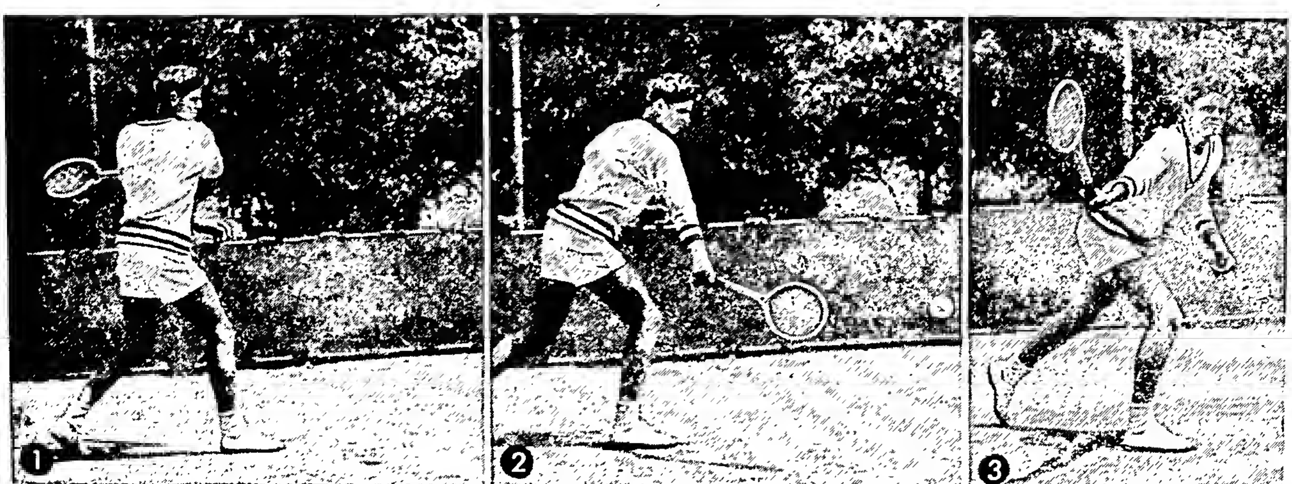
THE MOST IMPORTANT STROKES IN TENNIS



THE SERVICE. For this stroke the server must stand behind the base line. 1. He tosses the ball high in the air, directly over his left eye. 2. Hitting power is built up by a full, deep backswing. 3. Server reaches as high as possible to strike the ball, shifting his weight forward. 4. He follows through by pivoting slightly to the left, keeping his eyes on the ball.



THE FOREHAND DRIVE. With his left side turned to net, the receiver awaits ball with racket held back. 1. Watching ball closely he starts his swing, holding racket level. 2. The receiver strikes the ball as it comes opposite his left hip, pivoting his body at the hips and shifting his weight to his forward foot. 3. Follow-through carries the racket across the body.



THE BACKHAND DRIVE. Here receiver stands with right side turned to net, racket held behind left side. 1. During swing, he shifts weight to his forward foot. 2. The ball is hit with racket held almost level, wrist stiff. 3. In follow-through, the racket is held well out from body and brought beyond right shoulder. (The pictures show a high-school state tennis champion.)

it over the net or sends it outside the court, he loses the point. After the service has been returned either player may hit the ball before it has bounced—"volley" it—if he wishes. The ball often passes back and forth across the net several times before one of the players fails to return it. The service alternates, first from the right, then from the left court, and a player continues to serve until he wins or loses a game, when the service passes to his opponent. The doubles game on the larger court—with two players on each side of the net—is played in the same manner, except that the partners alternate in serving.

Other Technical Terms of Tennis

The first point won makes the score 15, the second point 30, the third 40, and the fourth wins the game unless each player has scored 40. In that case the score is *deuce*, and in order to win the game thereafter one player or the other must take two points in succession. The scores "15 to 0" and "30 to 0" are called "15 love" and "30 love"; the opposite are "love 15," and so on. The first of the two points after deuce is called *advantage in* if won by the server and *advantage out* if won by the receiver.

At the end of each game the player who has served becomes receiver while his opponent serves. The play continues until one player wins six games. This is a *set*. But if the score goes to five games all, the set stands at deuce. Then one player must win two consecutive games to win the set. Sides are changed after each set, except in official games where they are changed after each odd-numbered game. A match is two out of three sets or three out of five.

The Fundamental Strokes of Tennis

The chief return strokes, the *forehand* and *backhand* drives, are shown on the preceding page. A ball lofted high over an opponent's head is a *lob*. A *smash*, used near the net, is a hard overhand stroke. In a *half-volley* the racket meets the ball at the very start of the bounce.

The *service* puts the ball in play. The pictures on the preceding page, show a flat, straight serve. It should be mastered first. Another type is the *slice*, in which the racket is swung down from right to left, imparting a spin to the ball. In the *American twist* the racket moves from left to right. The ball curves toward the side lines as it crosses the net but "breaks" back on the bounce.

Lawn tennis rewards careful attention to technique. Quickness of mind, eye, and limb are essential—and endurance too, for the game is fast and strenuous.

The Father of Lawn Tennis

Court tennis traces its origin to the Middle Ages and enjoys prestige as the traditional game of kings and nobles in France and England. It is played in a walled and roofed court. Around three walls of the court runs a corridor with a downward-sloping roof ("penthouse"). A net divides the court into "service" and "hazard" sides. The rackets used are strong and heavy, and the interior of the ball is of cloth. In general, the ball, struck from the service court, must go over the net, hit the side penthouse roof or the wall above it, and must rebound into the service court of the hazard side; otherwise it is a pass or a foul. The score is counted as in lawn tennis.

Table Tennis, Contest of Timing and Speed

One of the fastest of ball games is *table tennis*, also known under the trade-mark of Ping-pong. The table is nine feet by five, with its top surface two and one-half feet from the floor. The net is six inches high. It extends across the width of the table and projects six inches on either side. The hollow celluloid ball, about one and one-half inches in diameter, is struck with a wooden paddle, usually covered with rubber, leather, or sandpaper.

The server stands behind the table and between the imaginary extensions of its sidelines. In serving he must make the ball bounce first in his own court before it clears the net. After service, the ball must be hit on the first bounce and may not be hit on the fly as in lawn tennis. Each miss counts one point for the opponent. Service changes hands after each five points until one player has scored 21—the game. Should the score reach 20 all, the service changes after each point, and the first player to score two points more than his opponent is the winner.

TENNYSON, ALFRED (1809–1892). For most of Queen Victoria's reign, Alfred Tennyson was England's poet laureate. Tennyson well deserved this high honor. He chose simple themes and subjects, and he wrote for a large, popular audience. He was a technical master of the art of poetry. His metrical skills, his rhythms, and his ability to match sound and sense were unsurpassed in the Victorian Age.

Tennyson's grandfather was a member of Parliament. His father, a spirited fellow in his youth, was disinherited, and the family fortune went to a younger son. The displaced son traveled for several years, then settled down to become a minister in the Church of England. His parish was in the little village of Somersby, Lincolnshire, and there Alfred was born on Aug. 6, 1809. He was the fourth child; eventually there were 12 children in all. In a house as full as this there was no place for a namby-pamby. Their games were wild, rough, and imaginative, with much storytelling about knights and soldiers.

When Alfred was seven, he went to live with his grandmother at Louth. There he attended a grammar school ruled by a violent-tempered master who applied the rod to dullards and budding poets alike. At 11, the boy was brought home to study under his father. When he was not studying or wandering about the countryside exploring caves or freeing animals from hunters' traps, he wrote poems. One was a long epic of 6,000 lines, written when he was only 12.

Strivings and Disappointments

In 1827 Alfred and his brother Charles published a volume of their early poetic efforts, 'Poems by Two Brothers', for which they were paid 20 pounds. Few boys of 18 have ever earned any money writing poems. The next year he went to Trinity College, Cambridge. There his friendly ways, his habit of smoking a large pipe, and his excellent poetry soon

got him membership in the "Apostles," a club for undergraduates. Among his closest friends was the brilliant Arthur Hallam, who often visited the Tennyson home at Somersby. Hallam became engaged to Alfred's sister, Emily. Young Tennyson continued working, and won a medal for a poem in 1829. During the summer vacation of 1830 he and Hallam dashed off to the Spanish Pyrenees to help a rebel general in his struggle against Spain's tyrannical monarchy.

Tennyson's father died in 1831 and the young man had to leave Cambridge without completing his studies. At home Tennyson acted as man of the house. By now he was fully grown, large and strong. He once demonstrated his strength by lifting a small pony and carrying it several yards. The country lads were always astonished when he beat them at "putting the stone" (shot put) or "hurling the crowbar." When not gardening or caring for the rectory grounds he was writing poetry. In 1833 he published a second volume of poems which included 'The Lady of Shalott' and 'The Lotus-Eaters'.

That same year Hallam died. Grief-stricken, Tennyson turned to questions of death, faith in God, and immortality in a series of short poems. These were eventually linked together in the elegy 'In Memoriam'.

By 1837 Tennyson's financial affairs were in such poor shape that he had to give up plans to marry his fiancée, Emily Sellwood, but he did not give up hope. The best of his earlier poems and some new ones ('Ulysses', 'Locksley Hall') were published in a two-volume edition in 1842. He was now regarded as the chief young poet of the day, but his income was still too small to permit marriage. He risked his slender inheritance on a get-rich-quick scheme to develop a wood-carving machine—and lost everything. Seeing his despair, friends got the English government to award him a pension of 200 pounds a year.

YOUNG TENNYSON

Samuel Laurence painted this picture of Tennyson before the poet won fame and honors.

Success and Security

From then on, things began to mend. 'The Princess' (1847), his next poem, supported women's rights and was well received by the public. 'In Memoriam' (1850) expressed Tennyson's own doubts and fears about religion and science. This poem also appealed to people troubled by the same misgivings. His answers were their answers and, except for a few critics, everyone was pleased.

Royalties began to flow in, and Tennyson and Miss Sellwood were married in 1850. (They later had three children.) That same year he was appointed poet laureate. He bought a fine home and farm on the Isle of Wight where he entertained friends, famous persons, and celebrity hunters by the score. He had established himself as the most successful poet of his time. As poet laureate he wrote some memorable poems for special occasions—'Ode on the Death of the Duke of Wellington' and 'The Charge of the Light Brigade'. Other poems, such as 'Dora', 'Enoch Arden', and 'The Miller's Daughter', endeared him to those who liked their sentiment sweet.

Tennyson spent his later years creating a cycle of Arthurian poems, 12 in all, called 'Idylls of the King'. The poet made symbols of Arthur and the Round Table knights. They represent the social and moral problems of Victorian England: virtue in conflict with vice. The 'Idylls' continued the lessons he had earlier taught through the classical themes of 'Ulysses' and 'Tithonus'. He also wrote several verse dramas dealing with events in English history. None of them was very successful on the stage.

Queen Victoria's prime ministers had often urged Tennyson to accept a baronetcy (and with it, the title of "Sir"), but he had always refused. In 1883 he reluctantly accepted a barony offered by Prime Minister William Gladstone; the honor was formally bestowed the next year, and Tennyson thereafter bore the title "Lord." He was the first English writer to win so high a title for authorship alone.

Tennyson remained alert and vigorous to the end of his life, always fond of travel and yachting. In 'Locksley Hall Sixty Years After' (1886) he discussed many questions then agitating the nation. In 'Merlin and the Gleam' (1889) he wrote of high ambitions with youthful enthusiasm. 'Crossing the Bar' was written when he was 81, two years before his death. He died Oct. 6, 1892, and was buried in the Poets' Corner of Westminster Abbey, where many of England's great poets lie.

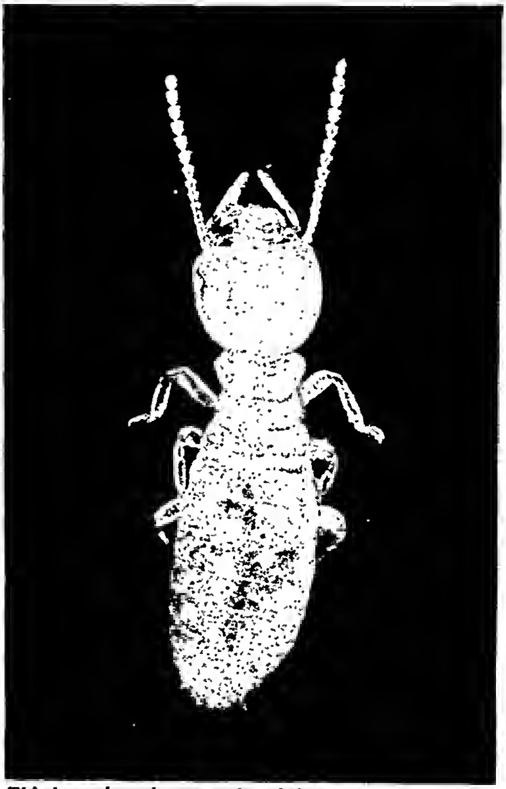
TEREDO. Though called a shipworm by many, the teredo is actually a mollusk, like the oyster. Wormlike in form, grayish white, with a wispy forked tail and a head resembling a clam, the common species (*Teredo navalis*) attains a length of one to two feet. Some tropical species grow to six feet. They begin as free-swimming larvae, are carried by currents against wharves and the hulls of wooden ships, and begin boring in immediately. In a few hours, only the siphoning tail is left in contact with the water. Wood is their food, which they pulverize with their tiny rows of teeth, and they are capable of devouring the toughest oak. A four-year teredo invasion of San Francisco Bay damaged wharves and docks to the extent of 25 million dollars. Yet teredos are so delicate that they can scarcely be handled. To combat them, wood is treated with creosote.

TERMITES *and Their Amazing* SOCIAL ORGANIZATION

TERMITES. Sometimes termites are called "white ants," but they are not ants. They are more nearly related to cockroaches, although their social organization is antlike. They can readily be distinguished from ants by the lack of a "waist" where thorax joins abdomen.

Of the 56 species in the United States the most important are the "ground-nesting" termites. A typical colony lives underground in a damp, chamber-like nest. The colony is made up of four different adult forms or castes. These are the royalty, the nobility, and two proletarian groups—the soldiers and the workers. The royalty consists of the ruling king and queen, who carry on the work of reproduction, and the winged young kings and queens, who will leave the nest to start new colonies. The nobility consists of wingless adults, who take over the work of reproduction if the king or queen dies. The soldiers and the workers—gray-white, wingless, entirely blind, and only about one-fourth of an inch long—comprise most of the colony. They include both male and female forms but they are sterile. The soldiers guard the nest against insect enemies, chiefly ants. The workers keep the colony supplied with food.

A DESTROYER OF WOOD



This is an American termite of the worker caste, magnified ten times. Sightless and wingless, it shuns daylight and is seldom seen by householders. But the damage to buildings and furniture done each year by these insects runs into millions.

A Cellulose-Eating Partnership

It is the food-getting activity of the termite workers which makes them so destructive, for their main food is wood fiber or cellulose, which they get from dead trees, from rotting plant material in the soil, or from fence posts, telephone poles, house timbers or furniture.

Cellulose is indigestible to nearly all animals, large or small, and termites are no exception to this rule. But the termite workers have formed a remarkable partnership with tiny creatures (protozoans), which they harbor in their intestines. The workers chew and swallow the woody fiber, and the protozoans digest it for them. The soldiers also have protozoan partners and can digest wood fiber after the workers have chewed it up. Their enormous fighting jaws prevent them from gathering this fiber for themselves. The royalty and nobility lack the protozoans and must be fed on digested cellulose secreted by the workers.

Tunneling from the nest, the workers ordinarily attack a house by entering the timbers in contact with the ground. If a house has a stone foundation, the termites may build earthlike shelter tubes over the foundation and up to the beams. Under a porch they may erect towers a foot or more high to reach the wooden floor. Once inside the woodwork of a building, they tunnel in all directions, without ever making an opening that shows on the surface, for termites shun the open air. The first sign of their presence may be the collapse of a wall or of pieces of furniture that they have entered at the point where the legs touch the floor. They work in large numbers. As many as 4,000 have been counted in a cubic foot of wood.

Once a year the young kings and queens leave the parent nest in pairs and each pair starts a new colony near by. They then shed their wings. Within a short time the young queens may be laying eggs at the rate of three to five thousand a day. To rid a locality of termites would require the destruction of every one of the nests. More practical are the measures adopted to "insulate" buildings against them by treating their woodwork with poisonous chemicals or by sheathing possible points of attack with metal.

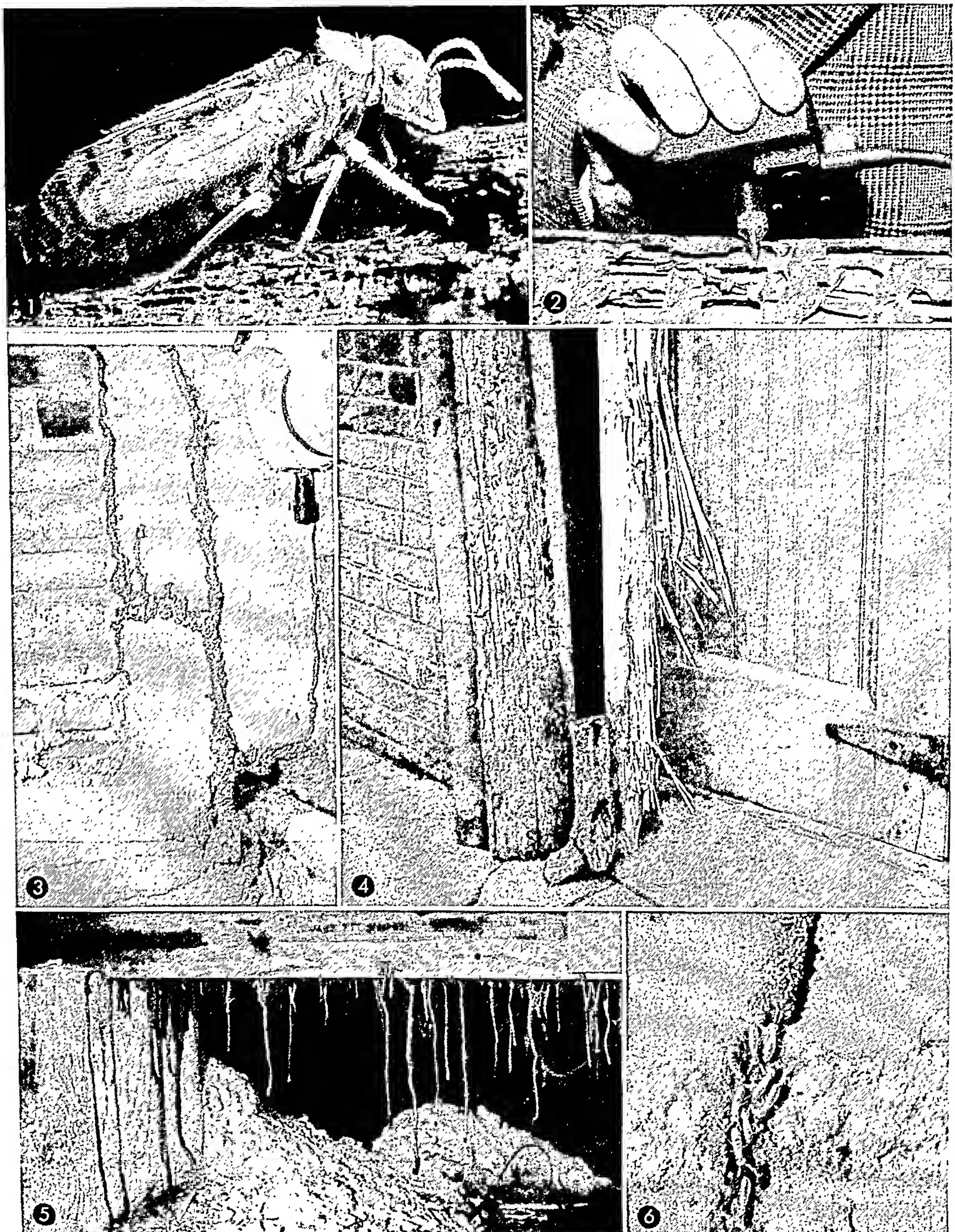
Less destructive than the "ground-nesting" termites are the "dry-wood" termites in the United States. They do not live in the soil, but fly to and attack wood directly. Their colonies are small.

Mound Builders

In South America, Africa, and Australia live the mound-building termites. Their brown mounds or *termitaries* often crowd together in a close group with slender towers rising like a city of skyscrapers. Hard as concrete, they are built up with saliva-soaked particles of soil. In the group may be some that were started by the termites hundreds of years ago and are now 20 feet high and 40 feet wide at the base. The base is usually roughly oval, with the long axis pointing north and south, so the sun can reach both of the broad side walls and keep them dry.

Inside the walls of each termitary the same complex social order prevails as among the ground-nesting termites. The king and the queen occupy the royal chamber. The king is small, but the queen, distended by as many as 75,000 eggs, may become four inches long. Some of the larger specimens lay one egg each second, twenty-four hours a day, for their span of usefulness,

TERMITES AT THEIR SILENT BUT RUINOUS WORK



1. Here a termite (shown magnified many times) gnaws away at a piece of wood. 2. A pick-up microphone tests wood for termites. It amplifies noise thousands of times, making the bite of a termite sound like rice dropping on paper. 3. To cross concrete, termites build long earthlike shelter tubes. Thus they avoid exposure to the air. 4. Though the outer surface of wood appears in good condition the under side is virtually devoured. 5. Here termites re-establish contact with the soil by building tubes down to the ground. 6. This shelter tube is cut open to show termites moving along their passageway.

SKYSCRAPERS OF THE TERMITE WORLD

In South America, Africa, and Australia, certain species of termites build mounds that tower as high as 20 feet. The outer walls are molded of earth particles held together by moisture and baked hard as concrete by the sun. Inside the walls, the termites fashion chambers and passageways, each having its special use. Note the provisions for ventilation and drainage. These mound colonies are even more highly organized than the underground colonies of termites described in the text. For clearness, the divisions in this cross-sectional drawing are made more precise than they are in real life.

which is three to ten years. She is pampered and stuffed with food by devoted attendants. The eggs are taken by nurses, washed with saliva to prevent mold, then carried to the hatchery and placed in well-ordered piles. The hatchery is kept exceptionally warm by small heaps of fermenting vegetation.

Young members of royal caste loll about, waiting to go forth to establish colonies of their own. The sightless soldiers, with their strong scissors-like mandibles, stand guard at every turn of the galleries and tunnels. Other soldiers, equipped with tough helmets to check any onrush of ants, guard the entrances from the outside world. The soldiers of some species have snouts through which they spray on their enemies a sticky liquid that entangles their legs and also stupefies them. The worker caste gathers bits of wood to feed the entire community. Some colonies grow mushrooms in fungus gardens. Some have community "cows"—small beetles (*termitophiles*) living only in termite nests and secreting a fluid relished by the termites.

Termites belong to the order *Isoptera*. The scientific name of the common subterranean or "ground-nesting" termite is *Reticulitermes flavipes;* of the Florida "dry-wood" termite, *Cryptotermes brevis;* of the chief African mound builders, *Termes bellicosus*.

TEUTONS. Those peoples who speak any one of the various Teutonic languages—English, German, Dutch, Flemish, and the various Scandinavian tongues—are properly grouped together as "Teutons," though the name is at times more narrowly applied to the people of Germany, as the more numerous stock. The name "Teutonic invasions" is often applied to the wandering of Germanic peoples, from the 4th to the 9th centuries inclusive, which overturned the Roman Empire in the west and established the nations of western Europe in practically their present locations. The name Teuton was originally the name of an ancient German tribe that dwelt north of the Elbe, and first appeared in the history of Europe along with the Cimbri, about 300 B.C. (*See* Europe; Goths; Northmen; Roman History.)

The STIRRING STORY *of the* "LONE STAR STATE"

TEXAS. The "Lone Star State," as Texas is popularly called, has a rare distinction. Of all the states, it alone was an independent republic before it joined the Union. During its colorful history six flags have flown over it. La Salle raised the French standard over a short-lived colony on the coast. The other flags were the Spanish, the Mexican, the "lone star" banner of independent Texas, the Stars and Stripes, and the flag of the Confederacy during the Civil War.

Texas has riches enough to support an independent nation. It is by far the largest state in the Union. In population it ranks sixth. It has rich oil and gas fields, vast farms and ranches, and many busy industries. For years Texas has been one of the richest states in farm income. Enormous crops are harvested in many parts of the state, including the western irrigated areas. The nation's largest herds of cattle range over the grasslands. Texas industries turn out products ranging from hosiery and cotton goods to ocean-going oil tankers. Ships of many nations dock at its ports, and its products are carried all over the world.

The historic Alamo, now in the heart of San Antonio, was the cradle of Texas liberty. Here a staunch band of Texas patriots died in its defense.

How Big Is Texas?

Cross-country travelers are amazed by the size of Texas. The state covers more territory than Wisconsin, Illinois, Michigan, Indiana, and Ohio combined. The irregular southwestern boundary between Texas and Mexico follows the lower course of the Rio Grande (the Spanish name for "big river") for 1,250 miles (*see* Rio Grande). The state's southeast coast for 400 miles is on the Gulf of Mexico.

From Texline in the northwest corner of the Panhandle, the northern projection of the state, to the Rio Grande's mouth, is about 800 miles. It is nearly as far from El Paso on the western tip to the Sabine River on the east. This is greater than the airline distance from Chicago to New York City. Texas has more miles of railroad than any other state. The total mileage is enough to reach nearly two thirds of the distance around the earth.

Abundant Soil and Varied Climate

Within the great area of Texas, there is as wide a range of soil, climate, and plant life as there is between Florida and Connecticut. In the east, Texas has rainfall as ample as that of fertile farming states farther east. The western part lies in the dry Great Plains. There wells are needed for livestock and irrigation for crops.

Temperatures are equally varied. The annual average of the state is about 65° F. But such figures mean little over so vast an area. Average temperatures during January range from about 34° (almost freezing) in North Texas to about 60° along the Gulf. During July the average temperatures vary from 75° in the mountainous region west of the Pecos River to 87° in the valley of the lower Rio Grande.

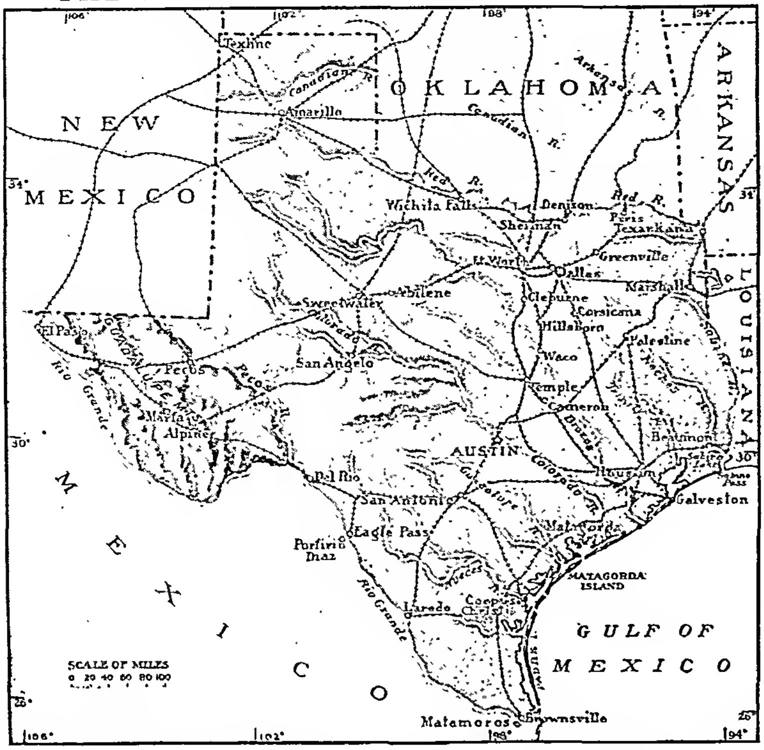
The state has three main types of climate—marine or coastal, continental, and mountain. The marine climate along the Gulf has fairly even temperatures in all seasons. The continental climate of most of the state is subject to sharp variations between day and night and from season to season. The mountain regions have dry, clear days, with sudden dips in temperature at nightfall.

A Leading Agricultural State

One of the major sources of livelihood in Texas has always been farming and stock raising. Commerce employs the most people, followed by agriculture and manufacturing. Mineral production and manufacturing yield about the same income, and they are the state's leading sources of wealth. Texas, however, is a top-ranking state in annual cash income from farming.

Texas grows nearly every crop found in the north temperate zone. Its chief cash crop is cotton, and Texas leads the nation in output. On large cotton farms in the south and west, relatively few laborers

THE LARGEST STATE IN THE UNION



This relief map of Texas shows clearly the slope of its vast surface from northwest to southeast, with parallel rivers running to the sea. One of the highest sections of the state is the mountainous western part, beyond the Pecos River. Another high region is the Panhandle, the rectangular projection at the north.

are needed. Mechanized equipment is widely used to plow, cultivate, plant, dust, and pick the cotton.

Texas leads all states in growing sorghum. Most of it is fed to livestock as either forage or grain. In rice growing, the state is second to Louisiana in production but ranks first in crop value. Other important crops are corn, wheat, and peanuts. Also valuable are truck crops, citrus fruits, peaches, pears, pecans, grapes, and strawberries and other berries.

Texas has more cattle and sheep than any other state. It ranks first in wool production and first in cattle marketing. It also stands high in the raising of hogs and in egg and milk production.

Wealth from Natural Resources

In the total value of its mineral products Texas ranks first among the states. Its leadership is due chiefly to its vast production of crude petroleum, in which it is also first in the nation. Petroleum wells have been drilled in almost every part of the state, aud they maintain a steady flow of this precious fuel. Texas leads the nation in the output of natural-gas liquids and natural gas. These petroleum products are shipped by pipelines, tankers, and railroad cars all over America and to world markets.

Among other important mineral products are sulfur, cement, clays, sand and gravel, gypsum, stone, salt, lime, and helium. The state also has large deposits of lignite, or brown coal.

Next to food and petroleum products, the state's most valuable industries are the manufacture of chemicals and machinery, particularly oil-field equipment.

Texas mills saw more than a billion board feet of lumber a year, mostly pine. At Lufkin is a paper mill where Southern pine is converted to newsprint.

Passing through Texas the traveler is also likely to see a variety of other trees. There are white oak in level stands, cypress in the swamps, pecan, elm, willow, blackjack, cottonwood, and walnut along streams, cedar covering the hills, groves of live oak, mesquite patches, and stretches of Douglas fir.

A Broad Array of Rivers

Nearly all the rivers of Texas empty into the Gulf of Mexico. They flow generally southeast along the land's slope from the western mountains and high plains to the coast. Since most of them arise in the Great Plains they are extremely variable in flow. Long stretches may consist of sluggish pools and a thin trickle of water for months at a time; but the stream beds can become torrents during periods of heavy rainfall or when winter snows melt at the headwaters.

The extreme northern edge of the state lies in the Mississippi basin. Here the Red River forms the Texas-Oklahoma boundary for nearly 400 miles, and the Canadian River crosses the Panhandle to join the Arkansas. To the south the chief rivers are the Sabine, which forms part of the boundary between Texas and Louisiana, the Neches, Trinity, Brazos, Colorado, Guadalupe, San Antonio, and Nueces. The Pecos, the largest river within western Texas, rises in New Mexico. After crossing into Texas it runs almost parallel with the Guadalupe Mountain range to its junction with the Rio Grande.

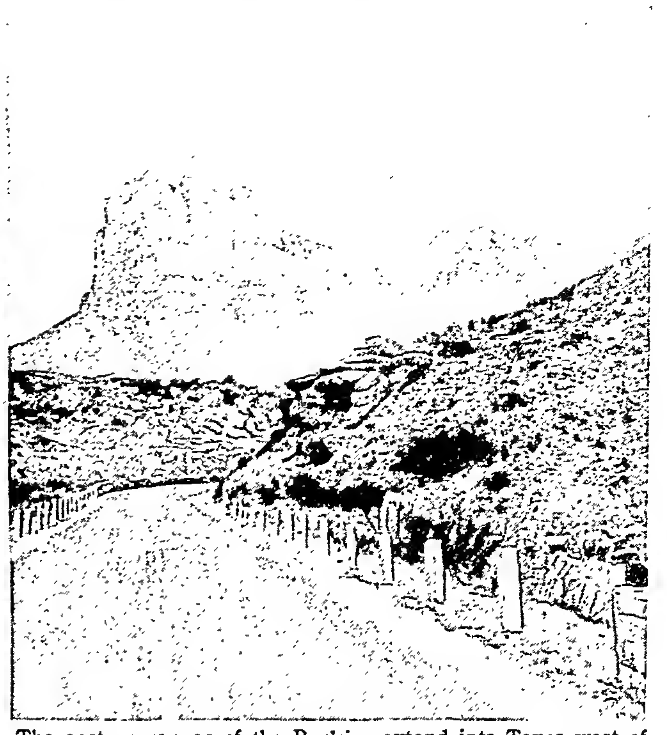
Since 1930, there has been construction of many dams and reservoirs for flood control, power, irrigation, and water supply. Denison Dam on the Red River forms Lake Texoma. Marshall Ford Dam creates Lake Travis and Hamilton Dam impounds Lake Buchanan, both on the Colorado. On the West Fork of the Trinity River are Bridgeport and Eagle Mountain reservoirs. Possum Kingdom Reservoir, held back by Morris Sheppard Dam, and Whitney Reservoir, under construction, are both on the Brazos River.

In 1953 occurred a splendid expression, of international co-operation when President Eisenhower of the United States and President Cortines of Mexico dedicated the Falcon Dam on the Rio Grande, about 75 miles below Laredo. Both Texas and Mexico will benefit by the water conservation, flood control, and hydroelectric power programs of the project.

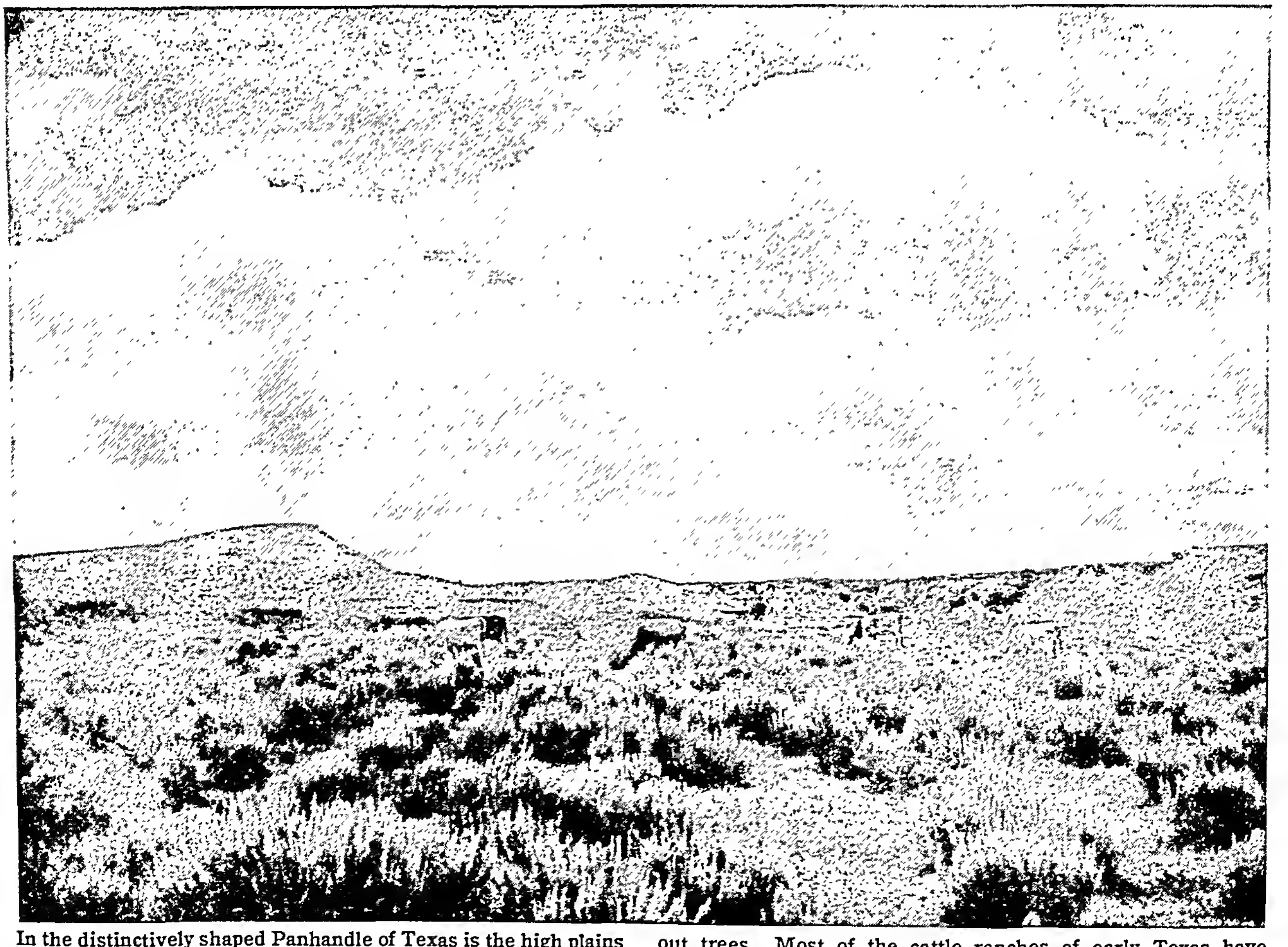
The Gulf and South Texas

The coastal plains region in south Texas is only a little above sea level. The Gulf deepens slowly and

The vast expanse of Texas includes many variations of scene and climate. In the semitropical Gulf of Mexico region near Orange is Shangri-La, a floral garden with moss-festooned trees.



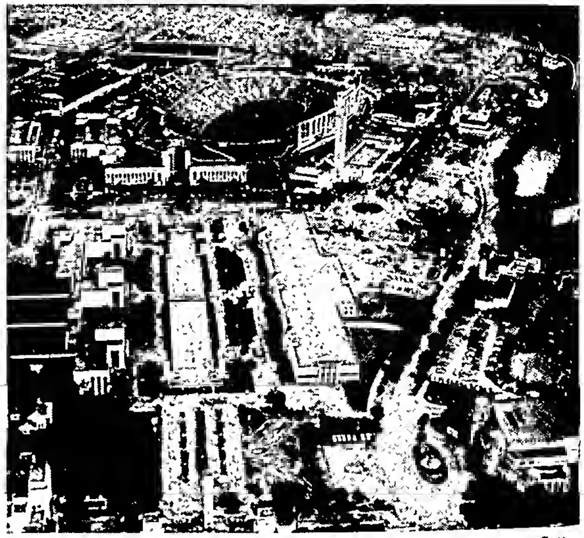
The eastern ranges of the Rockies extend into Texas west of the Pecos River. Here is the highest point in Texas, the 8,751-foot Guadalupe Peak. Nearby El Capitan rises 8,078 feet.



In the distinctively shaped Panhandle of Texas is the high plains section of the Great Plains, which continue on northward into Canada. The plains are semiarid, almost flat, and without trees. Most of the cattle ranches of early Texas have given way to wheat and cotton fields and livestock farms. This is the state's most important wheat-growing area.

THE TWO METROPOLISES OF VAST TEXAS

The South's largest city, great seaport, leading rail and industrial center—that is Houston, the first city of Texas.



One of the nation's largest state fairs and site of the Cotton Bowl of football fame is in Dallas, the second city of Texas.

along most of the coast lie long islands of sand, enclosing lagoons and bays. Padre Island is the longest, 160 miles in length. It is joined to Corpus Christi by a four-mile causeway (*see* Corpus Christi). Here are parks and other recreational facilities. Other large islands are Galveston and Matagorda.

By dredging rivers and the Gulf and building jetties, harbors have been opened. Galveston is a world-famous port for shipping cotton (*see* Galveston).

The Gulf Intracoastal Waterway extends for 1,100 miles along the Gulf coast from Brownsville on the Rio Grande to Apalachicola, Fla. It affords safe shipping between such cities as Corpus Christi, Galveston, and Port Arthur. Houston is 50 miles inland, but the Houston Ship Channel links it to the Gulf and the Intracoastal Waterway by way of Galveston Bay (*see* Houston). Other inland cities such as Port Neches, Beaumont, and Orange have dredged channels to the Intracoastal Waterway (*see* Beaumont). The Gulf Freeway, a superhighway between Houston and Galveston, was opened in 1952.

Petroleum, salt, and sulfur are found beneath the low coast plain. Ditches along the central and eastern rivers irrigate wide rice flats, and the truck farmers market figs, berries, melons, and potatoes. Farther inland to the north and west are cotton plantations and big cattle ranches.

The lower Rio Grande Valley was once a jungle of dry prairie growth. Now, thanks to extensive irrigation, it is a garden of cotton, citrus fruits, and vegetables. Brownsville, the chief city of this market basket, is also a winter resort. The city grew from Fort Brown, which was organized by Zachary Taylor during the Mexican War and was used as a fort until 1944.

Up the river lies Laredo, an important trade and tourist pathway across the Rio Grande to Mexico. It is the capital of a truck-farming district and the center of oil, natural gas, and coal production.

In colorful, prosperous San Antonio, third city in the state, new and old Texas live side by side, and military planes from Randolph, Lackland, Kelly, and Brooks Air Force bases maneuver over ancient mission buildings (*see* San Antonio).

Features of East Texas

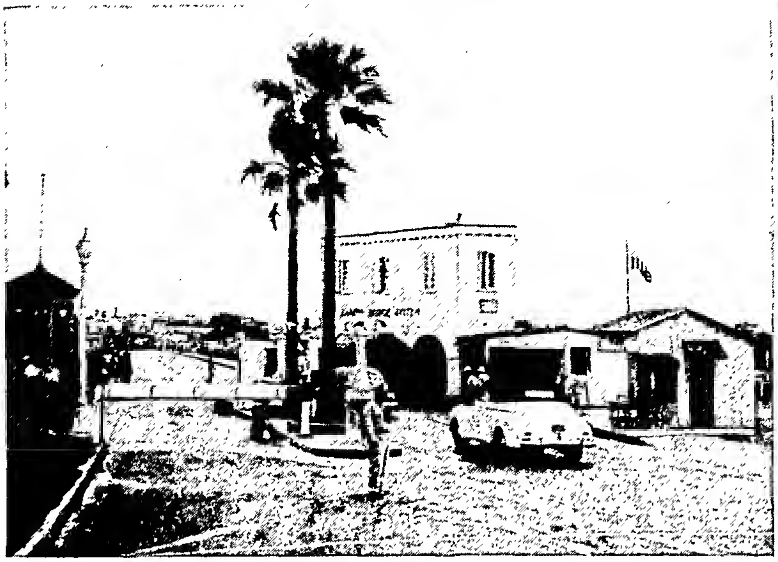
Austin is a planned city, founded in 1839, when it was chosen as the capital of the new Republic of Texas. It was then almost at the frontier and close to tribes of hostile Indians. The first Capitol was a large one-story frame building. It was surrounded by a stockade for protection against Indian raids as late as 1845, when Texas was admitted to the Union. Texas now has one of the finest Capitols in the country. The University of Texas, one of the leading institutions of the South, was opened at Austin in 1883 (*see* Austin).

Northeast of the capital is Waco, a progressive city on the banks of the Brazos, surrounded by rich cotton and farming country. Still farther north lies metropolitan Dallas. The second largest city in Texas, it is a large cotton market and financial center (*see* Dallas).

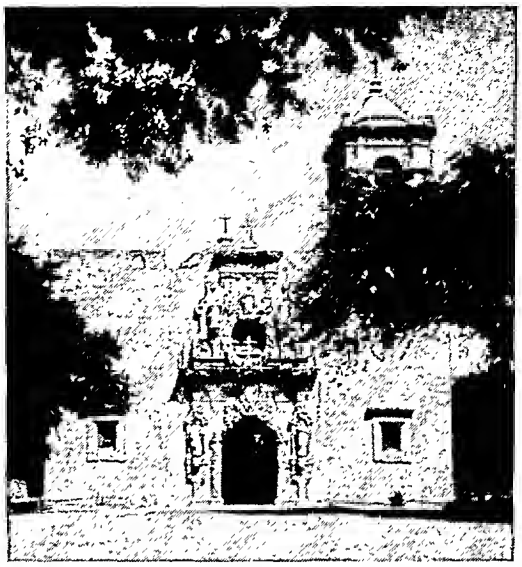
About 30 miles west of Dallas is Fort Worth. In the heart of the fertile black prairie region, this city owes its fortunes to cattle, oil, and grain (*see* Fort Worth). In the extreme northeast is Texarkana, half of which is in Arkansas. This city is a railroad center and market for hides and lumber. In the north central section near Oklahoma is Wichita Falls. It is an oil and gas center with thousands of acres of irrigated land nearby.

The lands of east Texas are covered by a vast patchwork of cotton, wheat, corn, oats, and sugar-cane fields, of truck gardens and peach orchards, and of pastures. In the pine and oak forests roam foxes, wolves, and a few bears and deer. Under the ground are iron, lignite, salt, gas, and a wealth of oil that has brought rich returns since the spectacular boom of 1930. To the south the ports of Houston,

COLORFUL CITIES IN THE SOUTH OF TEXAS



Laredo, on the Rio Grande, is a busy gateway to Mexico. Across the International Bridge is its twin, Nuevo Laredo, in Mexico.



San José Mission, founded in 1720 by the Spanish in San Antonio, is famed for the stone carving on its south window.

Galveston, Port Arthur, Beaumont, Orange, and Texas City link this important area with the Gulf of Mexico.

The Panhandle and West Texas

The eastern limit of what was once called the Great American Desert is the lofty Llano Estacado (Staked Plain) in west Texas. The name of the plain came from the story that Coronado, the Spanish explorer, drove stakes along his trail to mark his way back. This is part of the Great Plains region. In Texas, these plains extend northward into the Panhandle, a neck of land wedged between Oklahoma and New Mexico. For years stock raising was the major source of income here. Many farms of the Panhandle were ruined during the 1930's when dust storms carried away the rich topsoil. *Contour plowing* to hold the soil in place and dry-farming methods to retain moisture in the ground helped to rebuild the soil. However, overcropping during and after World War II and drought and dust storms in the 1950's again resulted in serious damage. Wheat is the chief crop.

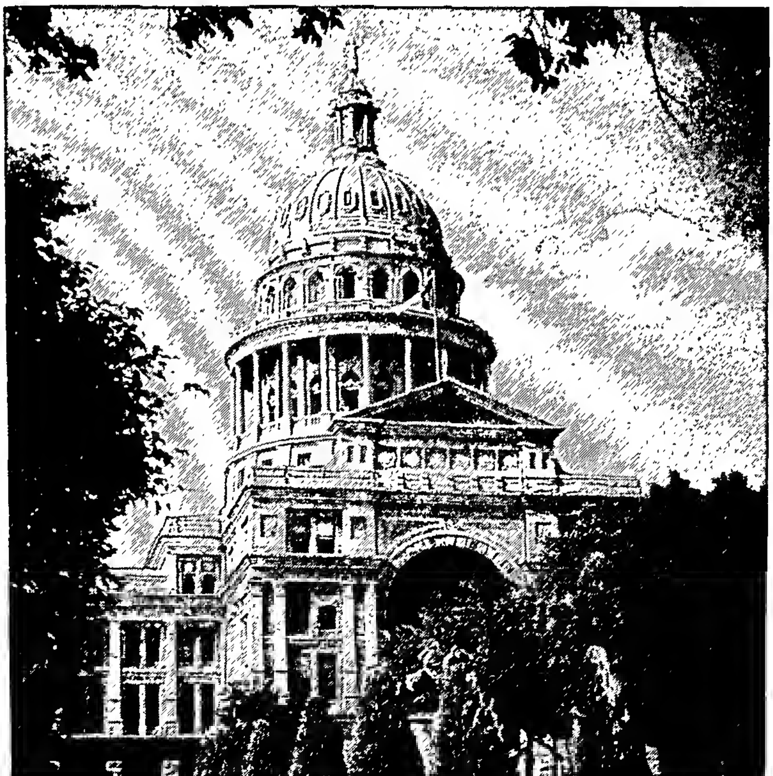
When agriculture was the sole industry, the Panhandle was thinly settled. But the discovery of oil changed the entire appearance of the area. Towns sprang up, and today derricks rise from the prairies.

Amarillo, the Panhandle's chief city, almost tripled its population between 1920 and 1930 because of booming oil and gas fields. Natural gas from the Amarillo field supplies much of the world's helium used in welding, for lighter-than-air craft, and in hospitals.

The changes that have taken place in the Panhandle have been even more marked in other parts of west Texas. Most of the immense ranches of the past have been replaced by stock farms, grain and hay farms, and cotton plantations. Cotton production has increased here because the boll weevil has been controlled. Oil and gas fields are being worked in almost every county; and west Texas has many oil refineries, natural-gasoline and carbon-black plants, and cotton mills.

Dairying and poultry raising are also important industries. Many herds of sheep and goats graze on the Edwards Plateau to the south.

THE LONE STAR HOVERS OVER THE STATE CAPITOL



The Goddess of Liberty holds a five-pointed star over the magnificent Capitol at Austin. The massive building is the nation's largest state capitol.

HIGH RANKING IN AGRICULTURE


Sorghum grows tall and abundantly in Texas to make the state the leading producer. This cereal grass is fed to livestock.


Another unusual crop in Texas is strawberries. Pickers fill this field of ripe berries in the lower Rio Grande Valley.

In north central Texas, at the eastern edge of the Staked Plain, stands Abilene. It is rich in oil deposits and fine farms. To the south and west is San Angelo, once a post on the cross-continent mail stage route and now an outstanding wool and mohair market. Lubbock lies northwest, the center of a wheat-growing and cattle-raising district.

Rugged Lands Beyond the Pecos

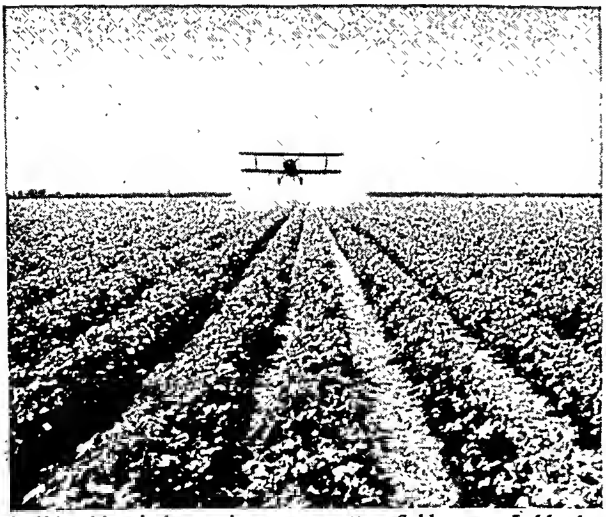
Texas climbs skyward in the Guadalupe Mountains west of the Pecos River. Guadalupe Peak is the state's highest point, 8,751 feet. Here is the wild, rugged Big Bend country within a curve of the Rio Grande. This area of deep canyons has been set aside as the Big Bend National Park (*see* National Parks). One county, Brewster, is bigger than Connecticut. Great cattle herds and flocks of sheep and goats graze through this lonely trans-Pecos land. Silver, mercury, some copper, gold, and lead are mined in the jagged mountains, and petroleum is found along the Pecos River.

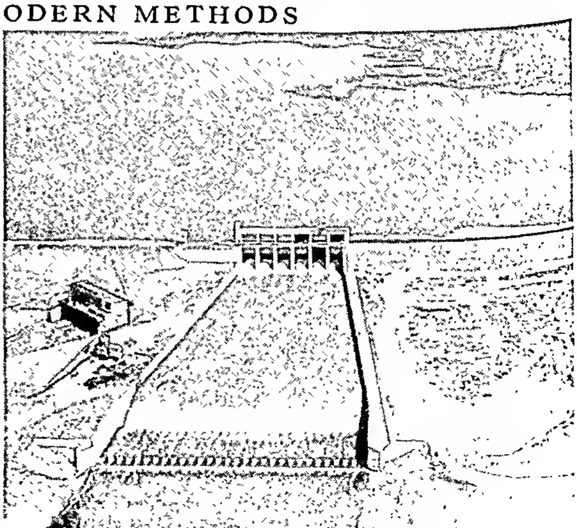
In this area crops grow only by irrigation. Near El Paso 70,000 acres are watered by the great United States reclamation project at Elephant Butte, N. M. (for picture, *see* New Mexico). A unique industry here is the manufacture of wax from the candelilla. The largest city on the Mexican border is El Paso, a health and pleasure resort. It has many important manufactures (*see* El Paso).

Rapid Rise in Population

During the early days of Spanish rule Texas attracted few white settlers. By 1806 the population was no more than 7,000. After the establishment of the Austin colony of Americans in 1821, settlers came in increasing numbers. Before the Civil War many came from the South, bringing slaves with them. Later newcomers came from the East and Middle West.

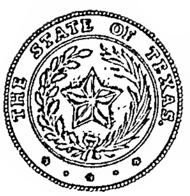
FARMING WITH MODERN METHODS


Swiftly this airplane wings over cotton fields near Lubbock and sprays the fine crop to protect it from harmful insects.


For irrigating farmlands, Texas and Mexico share the waters of the Rio Grande held back by Falcon Dam, below Laredo.

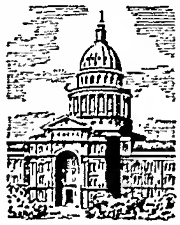
Continued on page 93

Texas Fact Summary

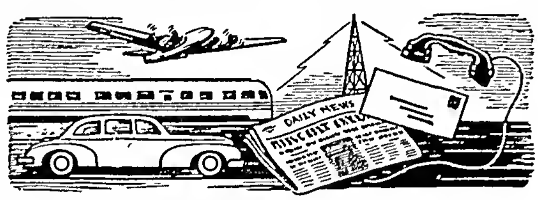


TEXAS (Tex.): Spanish explorers applied term *Tejas* ("friends" or "allies") to certain friendly Indian confederacies living in this region.
Nickname: "Lone Star State," for single star in Texas' flag since time of Republic of Texas.
Motto: Friendship.
Seal: Star encircled by branches of olive and live oak. Outer edge bears words, "The State of Texas."
Flag: For description and illustration, *see* Flags.
Flower: Bluebonnet. **Bird:** Mockingbird. **Tree:** Pecan.
Song: 'Texas, Our Texas'—words, Gladys Yoakum Wright and William J. Marsh; music, William J. Marsh.

THE GOVERNMENT



Capital: Austin (since 1845; capital of Republic of Texas, 1839–42).
Representation in Congress: Senate, 2; House of Representatives, 22. Electoral votes, 24.
State Legislature: Senators, 31; term, 4 years. Representatives, 150; term, 2 years. Convenes second Tuesday in January in odd years. No limit to sessions.
Constitution: Adopted 1876. Proposed amendment must be (a) passed by two-thirds vote of the legislature and (b) ratified by a majority voting on amendment.
Governor: Term, 2 years. May succeed himself.
Other Executive Officers: Lieut. gov., atty. gen., treas., comptroller, commissrs. of agriculture and general land office, elected; term, 2 yrs. Governor appoints secy. of state; senate approves; term, 2 yrs.
Judiciary: Supreme court—9 justices, elected at large; term, 6 years. Court of Criminal Appeals—3 judges, elected, term, 6 years; 2 commissioners, appointed by the court, term, 2 years. Courts of Civil Appeals—11; 3 judges each, elected, term, 6 years. District Courts—139; judges elected, term, 4 years. County courts—each county, 1; judges elected, term, 2 years.
County: 254 counties, each governed by a commissioner's court of 4 members and county judge. Courts and county officers elected; term, 2 years.
Municipal: Mayor-council most common; some cities have commissioners, council-managers, directors, or trustees.
Voting Qualifications: Age, 21; residence in state, 1 year; in county and district, 6 months. Poll tax requirement for voters of ages 21 to 59, inclusive.



TRANSPORTATION AND COMMUNICATION

Transportation: Railroads, 15,600 miles. First railroad, Harrisburg (now part of Houston) to Stafford's Point (now Stafford), 1853. Rural roads, 196,400 miles. Airports, 637.
Communication: Periodicals, 324. Newspapers, 696. First newspapers, *El Mejicano* (1813), *Texas Republican* (1819), both at Nacogdoches. Radio stations (AM and FM), 201; first station, WRR, Dallas, licensed 1921. Television stations, 23; first station, WBAP-TV, Fort Worth, began operation Sept. 29, 1948. Telephones, 2,299,400. Post offices, 1,984.

THE PEOPLE AND THEIR LAND

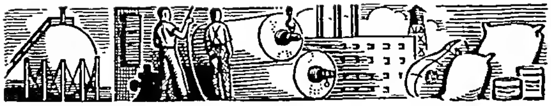
Population (1950 census): 7,711,194 (rank among 48 states—6th); urban, 62.7%; rural, 37.3%. Density: 29.3 persons per square mile (rank—35th state.)
Extent: Area, 267,339 square miles, including 3,826 square miles of water surface (1st state in size).
Elevation: Highest, Guadalupe Peak, 8,751 feet, about 100 miles east of El Paso; lowest, sea level.
Temperature (°F.): Average—annual, 65°; winter, 49°; spring, 65°; summer, 81°; fall, 66°. Lowest recorded, −23° (Seminole, Feb. 8, 1933, and other locations and earlier dates); highest, 120° (Seymour, Aug. 12, 1936).
Precipitation: Average (inches)—annual, 28; winter, 5; spring, 8; summer, 8; fall, 7. Varies from about 10 in extreme west to about 52 at east-central border.
Natural Features: Wide coastal plain of fertile lowlands and dense forests; broad, rolling prairies in north-central plains region; high plains extend south from the Panhandle to the Balcones Escarpment; west of Pecos River lies a high plateau broken by many mountains. Some important rivers: Brazos, Canadian, Colorado, Guadalupe, Neches, Nueces, Pecos, Red, Rio Grande, Sabine, San Antonio, Trinity.
Land Use: Cropland, 19%; nonforested pasture, 51%; forest, 22%; other (roads, parks, game refuges, wasteland, cities, etc.), 8%.

Natural Resources: *Agricultural*—diversity of climate, soils, rainfall makes for varied farming. *Industrial*—wealth of minerals, especially petroleum, natural-gas liquids and natural gas; forests. *Commercial*—middle position in southern United States; ports for trade with Central and South America; tourist attractions.

OCCUPATIONS AND PRODUCTS
What the People Do to Earn a Living

Major Industries and Occupations, 1950

Fields of Employment	Number Employed	Percentage of Total Employed
Wholesale and retail trade	590,224	21.5
Agriculture, forestry, and fishery	445,939	16.2
Manufacturing	372,909	13.5
Construction	236,276	8.6
Personal services (hotel, domestic, laundering, etc.)	230,317	8.3
Transportation, communication, and other public utilities	227,170	8.2
Professional services (medical, legal, educational, etc.)	216,964	7.9
Government	118,878	4.3
Mining	89,911	3.3
Finance, insurance, and real estate	88,814	3.2
Business and repair services	72,498	2.6
Amusement, recreation, and related services	26,076	0.9
Workers not accounted for	42,467	1.5
Total employed	2,758,443	100.0



What the People Produce

A. Manufactured Goods (Rank among states—11th)
Value added by manufacture* (1952), $3,185,658,000

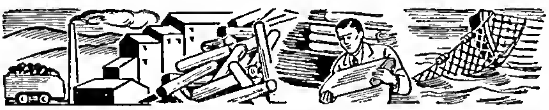
Leading Industries in 1947 (with Principal Products)	Value Added by Manufacture	Rank among States
PETROLEUM AND COAL PRODUCTS.. Petroleum refining	$359,680,000	1
FOOD AND KINDRED PRODUCTS.... Meat packing; bakery products; flour and meal; bottled soft drinks	337,558,000	9
CHEMICALS AND ALLIED PRODUCTS. Industrial organic chemicals; carbon black; cottonseed-oil mills	234,496,000	9
MACHINERY (EXCEPT ELECTRICAL). Oil-field machinery and tools	129,575,000	13
LUMBER AND PRODUCTS..........	95,988,000	5
PRINTING AND PUBLISHING.......	92,467,000	11
TRANSPORTATION EQUIPMENT.....	91,893,000	13

*For explanation of value added by manufacture, *see* Census.

B. Farm Products (Rank among states—3d)
Total cash income (1952), $2,192,092,000

Products	Amount Produced (10-Year Average)	Rank within State*	Rank among States†
Cotton lint.....	3,049,000 bales	1	1
Cattle..........	1,629,518,000 lbs.	2	1
Milk...........	1,937,000,000 qts.	3	10
Sorghums, grain	69,694,000 bu.	4	1
Sorghums, forage	3,620,000 tons		
Wheat.........	63,486,000 bu.	5	6
Hogs..........	537,265,000 lbs.	6	10
Eggs..........	243,000,000 doz.	7	3

*Rank in dollar value †Rank in units produced



C. Fish (Rank among states—9th)
(Marine waters and coastal rivers, 1950), catch, 97,251,000 lbs.; value, $11,265,000

D. Minerals (Fuels, Metals, and Stone)
Annual value (1951), $3,268,555,000
Rank among states—1st

Minerals (1951)	Amount Produced	Value
Petroleum.........	1,010,270,000 bbls.	$2,610,790,000
Natural-gas liquids.	108,531,000 bbls.	261,916,000
Natural gas.......	3,781,136,000,000 cu. ft.	204,181,000
Sulfur............	3,835,000 tons	81,900,000
Cement...........	17,643,000 bbls.	42,649,000

E. Lumber (Rank among states—9th)
1,168,000,000 board feet (5-year average)

F. Trade

Trade (1948)	Sales	Rank among States
Wholesale.........	$8,291,342,000	6
Retail............	6,518,877,000	6
Service...........	580,003,000	6

PLACES OF INTEREST*

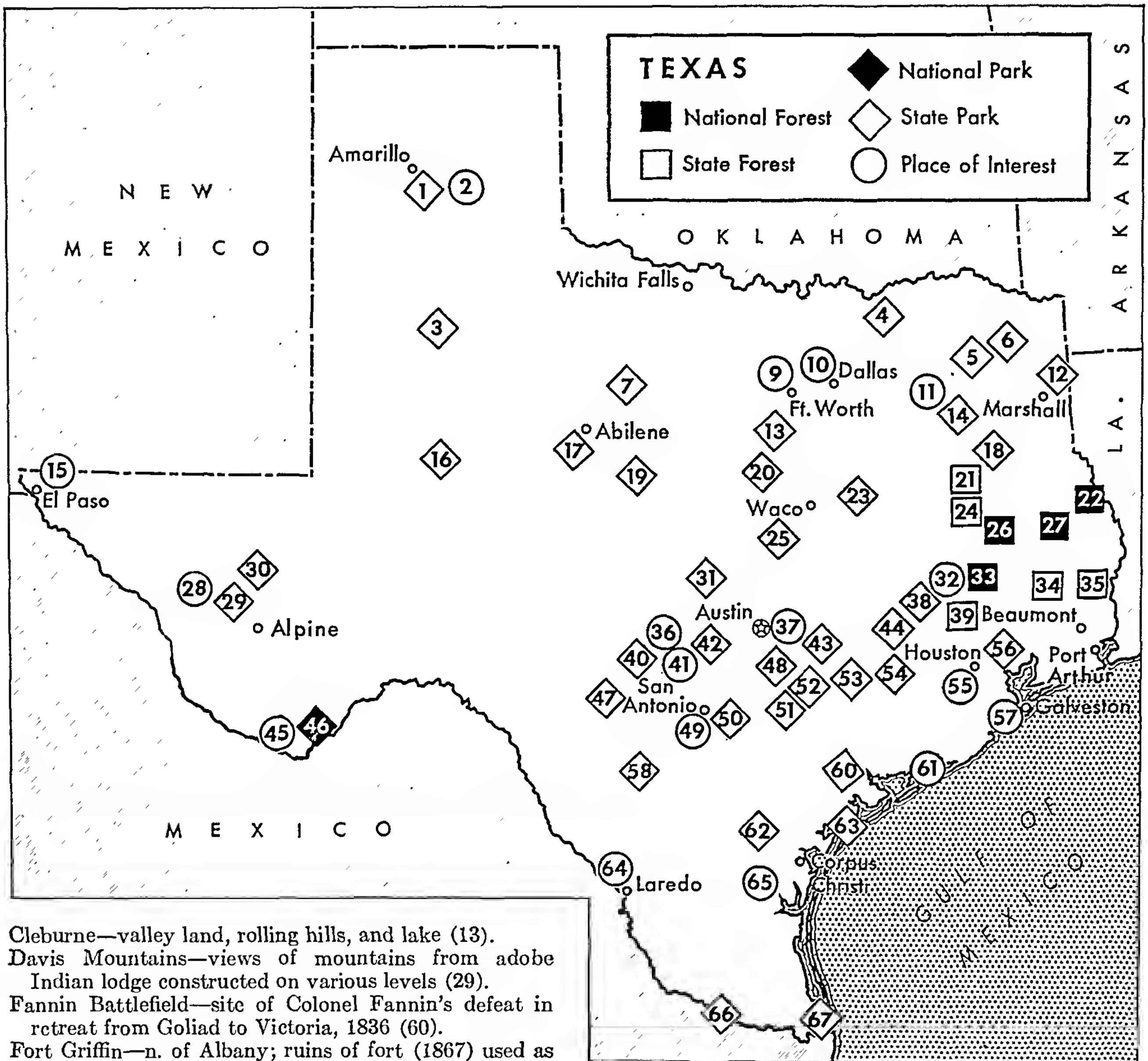
Alamo—Spanish mission regarded as "shrine of Texas liberty"; cenotaph (empty tomb), bearing names of all those who died here in the siege of 1836; restored chapel; museum of early relics; San Antonio (49).
Austin—State Capitol, Texas Memorial Museum, and O. Henry Museum (*see* Austin) (37).
Cave-without-a-Name—near Boerne; notable for variety of formations, splendid colors, marine fossils (41).
Christ Church—Matagorda; built 1839; original altar, priest's chair, baptismal font still in use (61).
Cristo Rey—monument of "Christ the King" on mountaintop overlooking El Paso and Mexican border (15).
Dallas—annual state fair held at Fair Park, a permanent exposition area, which contains Texas Hall of State and Cotton Bowl (*see* Dallas) (10).
El Paso—picturesque Mexican border city; International Museum exhibits Indian pottery, pioneer relics; Fort Bliss nearby (*see* El Paso) (15).
Enchanted Rock—near Fredericksburg; large outcropping of granite; dome rises more than 500 feet (36).
Fort Worth—Trinity Park; Botanic Gardens feature Albert Ruth dried-plant collection (*see* Fort Worth)(9).
Galveston—seaside resort protected from tidal waves by $7\frac{1}{2}$-mile-long sea wall (*see* Galveston) (57).
Goodnight Ranch—home of Colonel Goodnight, one of Panhandle's early settlers; buffalo reservation (2).
Grand Canyon of Santa Helena—rock walls tower above Rio Grande River; animal trails serve as paths (45).
Grand Saline—salt production can be observed (11).
Highland Lakes—recreation on Buchanan, Roy Inks, Marble Falls, Travis, and Austin lakes resulting from dams built by Lower Colorado River Authority and the federal government; northwest of (37).
Houston—many places to see (*see* Houston) (55).
Huntsville—home of Sam Houston; Steamboat House where he spent his last years, his law office, and Sam Houston Memorial Museum (32).
King Ranch—near Kingsville; covers nearly a million acres, one of largest cattle ranches in world (65).
Lake Texoma—created by Denison Dam on Red River between Texas and Oklahoma; north of (10).
Laredo—point of entry into Mexico by way of the Pan American Highway; International Bridge spans Rio Grande River to Nuevo Laredo, Mexico (64).
McDonald Observatory—at top of Mount Locke near Fort Davis; one of world's largest observatories (28).
San Antonio—the Alamo (*see above*); La Villita, city's original settlement; Spanish Governor's Palace; San José Mission National Historic Site; Brackenridge Park, immense woodland, includes Witte Memorial Museum, Pioneer Memorial Building; Mission Road to early churches; Randolph Field, "West Point of the Air," nearby (*see* San Antonio) (49).

STATE PARKS*

Abilene—at foot of Big Chief Mt. on famous Chisholm trail; 100,000-gal. swimming pool; near Abilene (17).
Balmorhea—developed around San Soloman Springs; contains world's largest walled swimming pool (30).
Bastrop—in Lost Pines Forest region; connected by 7-mile scenic drive with Buescher State Park (43).
Bentsen-Rio Grande Valley—near Mission; semitropical jungle; ebony trees, rare birds, other wildlife (66).
Big Spring—scenic drive to mountaintop (16).
Caddo Lake—forested area bordering lake; huge cypress grow in shore waters; excellent fishing (12).

*Numbers in parentheses are keyed to map.

Texas Fact Summary



Cleburne—valley land, rolling hills, and lake (13).

Davis Mountains—views of mountains from adobe Indian lodge constructed on various levels (29).

Fannin Battlefield—site of Colonel Fannin's defeat in retreat from Goliad to Victoria, 1836 (60).

Fort Griffin—n. of Albany; ruins of fort (1867) used as a shelter during early Indian raids; longhorn herd (7).

Fort Parker—on Navasota R., south of Mexia; large lake for water sports; highway to Old Fort Parker State Park which includes a replica of stockade (23).

Garner—30 mi. n. of former Vice-President Garner's Uvalde home; hilly area with many ravines along Frio R.; natural cave 75 ft. deep; deer, wild fowl (47).

Goliad—restored mission; remains of fort; shrine in fort chapel built nearly 200 years ago southwest of (60).

Gonzales—near site of 1st shots of Texas Revolution (52).

Goose Island—giant oak whose branches spread over 6,000 sq. ft. of ground; sea-fishing facilities (63).

Longhorn Cavern—Texas' largest underground cavern; chambers, odd rock formations; near Burnet (31).

Mackenzie—Lubbock; along Yellow House Canyon; camp of Indian expedition by Gen. R. S. Mackenzie (3).

Palmetto—near Gonzales; subtropical area including many mineral springs, rare plant growth (51).

Palo Duro Canyon—picturesque trails through colorful canyon; strange, erosion-carved rock formations (1).

Port Isabel—General Taylor's supply base during Mexican campaign; brick lighthouse built 1853 (67).

*Numbers in parentheses are keyed to map.

Possum Kingdom—2 sections along reservoir formed by Morris Sheppard Dam on Brazos River; east of (7).

San Jacinto—monument commemorates Gen. Houston's defeat of Mexicans (1836); battleship *Texas* berthed here as permanent memorial (*see* Houston) (56).

San José Mission National Historic Site—San Antonio; carved window and other sculptured ornamentation; restored granary, mill, soldiers' barracks (50).

Stephen F. Austin—original location of Austin's colony; reproduction of colonizer's log cabin; near Sealy (54).

Washington on the Brazos—monument to Texas' declaration of independence signed here March 2, 1836; reproduction of early capitol of Texas Republic (44).

Other state parks are as follows: Acton (13); Blanco (42); Bonham (4); Brazoria County Coastline, southwest of (57); Buescher (43); Daingerfield (6); Frio (58); Huntsville (38); Inks Lake (31); James Stephen Hogg (5); Jim Hogg (18); Kerrville (40); Lake Corpus Christi (62); Lake Whitney, west of (20); Lipantitlan, southeast of (62); Lockhart (48); Meridian (20); Monument Hill (53); Mother Neff (25); Thirty-sixth Division (19); Tyler (14).

NATIONAL PARK*

Big Bend—692,305 acres along great bend of Rio Grande; area abounds with picturesque canyons, volcanic rock formations; includes entire Chisos range (46).

STATE FORESTS*

E. O. Siecke (Newton Co.)—1,822 acres (35).
I. D. Fairchild (Cherokee Co.)—2,360 acres (21).
John Henry Kirby (Tyler Co.)—600 acres (34).
Mission (Houston Co.)—118 acres (24).
W. Goodrich Jones (Montgomery Co.)—1,732 acres (39).

NATIONAL FORESTS*

Angelina—391,300 acres; hdqrs., Lufkin (27).
Davy Crockett—394,200 acres; hdqrs., Lufkin (26).
Sabine—439,664 acres; hdqrs., Lufkin (22).
Sam Houston—491,800 acres; hdqrs., Lufkin (33).

LARGEST CITIES (1950 census)

Houston (596,163): inland ocean port; financial and industrial center; shipbuilding; produces machinery, chemicals, petroleum products; Texas Medical Center.
Dallas (434,462): leading inland cotton market; financial, insurance, fashion center; oil capital; makes clothing, petroleum products, machinery, metal products.
San Antonio (408,442): historic and colorful city; tourist trade; livestock and truck-crops market; meat packing.
Fort Worth (278,778): livestock and grain market; meat packing; milling; oil refining; aircraft manufacture.
Austin (132,459): state capital; University of Texas.
El Paso (130,485): gateway to Mexico; distributing point for Southwest; copper and lead smelting; oil refining.
Corpus Christi (108,287): gulf port; tourist industry.
Beaumont (94,014): river port; oil refining; shipyards.
Waco (84,706): textiles, tires, wood products, glass.
Amarillo (74,246): commercial center of the Panhandle.
Lubbock (71,747): commercial hub of South Plains.
Wichita Falls (68,042): center of area's oil industry.
Galveston (66,568): world port; exports cotton, sulfur.
Port Arthur (57,530): interior Gulf port; oil center.

EDUCATION

Public Schools: Elementary, 3,757; secondary, 1,818. Compulsory school age, 6 through 17. State Board of Education, consisting of 21 members popularly elected for 6-yr. terms, appoints state commissioner of education for 4-yr. term. Five county school trustees elected in each county for 2-yr. terms. County supts. elected for 4-yr. terms. County judges serve as county supts. in sparse counties. City school trustees generally elected; in some cities appointed by city council or board of aldermen. City supts. appointed by city school trustees.

Private and Parochial Schools: 564.

Colleges and Universities (accredited): Colleges—white, 44; Negro, 10. Junior colleges—white, 37; Negro, 2. State-supported schools include the University of Texas, Austin, with 4 branches—Galveston and Dallas (medical), Houston (dental), and Texas Western College, El Paso; Agricultural and Mechanical College, College Station, with 3 branches—Arlington State College, Tarleton State College, Stephenville, and Prairie View A. and M. College (for Negroes); Texas College of Arts and Industries, Kingsville; Texas State College for Women, Denton; Texas Southern University (for Negroes), Houston; Texas Technological College, Lubbock; Lamar State College of Technology, Beaumont; 7 state teachers colleges—East Texas, Commerce; North Texas, Denton; Sam Houston, Huntsville; Southwest Texas, San Marcos; Stephen F. Austin, Nacogdoches; Sull Ross, Alpine; West Texas, Canyon.

State Schools for the Handicapped: Texas School for the Blind, Texas School for the Deaf, Texas Blind, Deaf and Orphan School (for Negroes), all at Austin.

Libraries: City and town public libraries, 69; 35 independent county public library systems; 4 counties contract for service with city libraries. Library and Historical Commission, State Library, aids in developing public libraries; work headed by extension director. Texas Education Agency aids in developing school libraries; work headed by a consultant in libraries. Noted special libraries: Texas State Library, Mirabeau B. Lamar Library of Univ. of Texas, both in Austin.

Museums: Texas Memorial Museum, University of Texas, Austin; Panhandle-Plains Historical Society, Canyon; Dallas Historical Society, Dallas Museum of Fine Arts, both at Dallas; Museum of Fine Arts, Houston; Witte Memorial Museum, San Antonio.

WELFARE INSTITUTIONS FOR CHILDREN

State School for Boys, Gatesville; State School for Girls, Gainesville; State School for Negro Girls, Crockett; Mexia State School (for feeble-minded), Mexia; State School for Dependent Children, Waco.

CORRECTIONAL AND PENAL INSTITUTIONS

Texas State Prison System consists of 12 farms and factories at Huntsville (main prison, Goree Unit, and Wynne Farm), Sugarland, Richmond, Otey, Hobby, Brazoria, Sandy Point, Weldon, Midway, and Snipe.

THE PEOPLE BUILD THEIR STATE

1519—Alonso de Pineda, Spanish explorer seeking a water route across North America, explores Gulf of Mexico coast from Florida to Mexico.
1520—Francisco Garay sends expedition toward Texas from Mexico; reaches Rio Grande, 1523.
1527—Cruelty of Nuño de Guzmán arouses Indians along Rio Grande; Indians prohibit exploration of Texas interior for long period.
1528—Alvár Núñez Cabeza de Vaca shipwrecked on coast of present Texas; wanders among Indians, reaches Spanish post at Culiacán, Mexico, 1536.
1541—Francisco de Coronado crosses Panhandle seeking "Seven Cities of Cibola"; brings cattle to Texas; some escape to become wild Texas longhorns. Juan de Padilla, Franciscan missionary, accompanies Coronado; Indians kill him, about 1544.
1542—Luis de Moscoso leads Hernando de Soto's men from Mississippi River west to region beyond Trinity River; they turn back to the Mississippi.
1685—René Robert Cavelier, Sieur de La Salle's ship *Amiable* wrecked in Matagorda Bay; survivors build Fort St. Louis. After La Salle's death (1687), colonists killed by disease and Indians.
1689—Alonso de Leon, a Spaniard, sets out to destroy Fort St. Louis; finds the fort abandoned.
1691—Texas becomes a Spanish dominion; becomes a separate province of New Spain, 1723.

*Numbers in parentheses are keyed to map on preceding page.

Texas Fact Summary

1716—Spaniards establish six missions in east Texas.
1718—Mission San Antonio de Valero and presidio of San Antonio de Bexar founded on site of present San Antonio; mission is forerunner of the Alamo.
1722—Marquis de Aguayo establishes presidio of Los Adaes (now Robeline, La.); it is capital of Spanish Texas; capital moved to San Antonio, 1772.
1746—First public school in area opens at San Antonio.
1749—Presidio established on site of present Goliad.
1800—Philip Nolan leads party into Texas; Spaniards rout force, kill Nolan, March 21, 1801.
1803—France sells Louisiana region to U. S.; Spain rejects Jefferson's claim to Rio Grande as boundary.
1812—Bernardo Gutiérrez de Lara and Augustus W. Magee lead expedition of Americans into Texas, take San Antonio; driven out by Spaniards, 1813.
1817—Jean Lafitte, notorious pirate, operates from base on Galveston Island, leaves in 1821.
1821—Adams-Onís Treaty ratified, giving Spain control of Texas. Spain grants Moses Austin right to settle colony in Texas; his son, Stephen F., leads settlers to Columbus and to Washington. Mexico wins independence from Spain; Texas becomes a state of Mexico.
1823—Mexican government confirms Austin's grant; San Felipe de Austin founded on site of Austin. Shipment of cotton to New Orleans begins.
1825—Jared Groce builds first cotton gin in Texas.
1826—Short-lived Republic of Fredonia organized at Nacogdoches by rebellious American settlers.
1830—Mexico halts American immigration into Texas.
1832—American farmers and Mexican troops battle at Anahuac and Velasco. Convention at San Felipe demands increased liberties for American settlers.
1833—Convention at San Felipe drafts proposed state constitution for Texas; Austin takes document to Mexico and is imprisoned for almost two years.
1835—Battle of Gonzales, first battle of Texas Revolution, fought, October 2; Mexicans defeated. Provisional government set up at San Felipe.
1836—Texas declares independence at Washington (Texas); adopts constitution. Santa Anna captures Alamo, massacring Davy Crockett, James Bowie, and others; James W. Fannin and men massacred at Goliad. Sam Houston captures Santa Anna in battle of San Jacinto; made president of Republic of Texas, at capital, Columbia.
1837—U.S. recognizes the independence of Texas. Houston becomes capital 1837–39.
1839—Austin becomes capital, 1839–42. Cherokee Indians expelled from Texas.
1840—Comanche Indians attack settlers in Guadalupe Valley in greatest Indian raid in Texas history.
1841—Texans try to occupy New Mexico, but defeated.
1842—Mexicans raid San Antonio. Archives ordered returned to Houston; people of Austin prevent their removal in "Archive War." Washington on the Brazos River becomes capital, 1842–45.
1844—Karankawa Indians leave Texas.
1845—Texas annexed to U.S., December 29, as the 28th state; J. P. Henderson, governor; Austin, capital. New state constitution provides for free public schools. Baylor University chartered.
1846—First state legislature opens at Austin, February 16; Republic of Texas declared abolished.
1848—Texas claims all territory east of Rio Grande ceded by Mexico in Treaty of Guadalupe-Hidalgo.
1850—U.S. purchases Texas' claim to disputed land.
1857—Stagecoach service begins between San Antonio, Tex., and San Diego, Calif. Butterfield Stage Line links St. Louis, El Paso, and San Francisco, 1858.
1861—Texas secedes from Union, February 1; Houston opposes secession and is deposed as governor.
1862—Union forces capture Galveston, October 9; Confederates recapture it, January 1, 1863.
1865—Last battle of Civil War fought near Brownsville, May 12–13. Texas put under military government until 1869; slavery abolished in state.
1866—Oil discovered at Chireno.
1870—Texas ratifies 13th, 14th, and 15th Amendments; readmitted to the Union, March 30.
1874—Capt. Miffin Kenedy crosses Texas cattle with imported Indian brahman cattle. Fencing of open-range causes "fence-cutting wars," 1876–84.
1875—Comanches confined to reservations after raids; opens Panhandle and western plains to settlement.
1876—Col. C. Goodnight begins first large cattle ranch in Panhandle. Present state constitution adopted.
1881—Southern Pacific R.R. unites Texas and California.
1883—University of Texas opened at Austin.
1896—U. S. Supreme Court settles Greer County boundary dispute in Oklahoma's favor.
1900—Hurricane and tidal wave devastate Galveston; nearly 6,000 killed; townsmen create first commission type government in U. S. to rebuild city.
1901—Spindletop oil field discovered near Beaumont. First large packing plants built at Fort Worth.
1905—Terrell Election Law provides for direct primary.
1910—First official U. S. Army airplane flight takes place at Fort Sam Houston.
1915—Houston canal opened. Education made compulsory.
1927—Luling Foundation Farm for research established.
1930—East Texas oil field discovered. U.S. Air Force's Randolph Field near San Antonio dedicated.
1934—Intracoastal Waterway opened from Sabine River to Galveston Bay.
1935—Colorado River authorities created to develop river.
1936—Texas' Centennial celebrated at Dallas.
1939—McDonald Observatory opened near Fort Davis.
1942—Marshall Ford Dam on Colorado River completed.
1943—Denison Dam on Red R. completed; one of world's largest dams in volume; forms Lake Texoma, one of world's greatest reservoirs in volume and area.
1947—Explosion of nitrate ship devastates Texas City.
1949—Legislature bars Communist students and teachers from state colleges; passes antilynch laws. Biggest oil strike since 1930 made in Scurry County.
1950—University of Texas admits Negroes for first time.
1952—Democratic party in Texas endorses Dwight D. Eisenhower, Republican presidential candidate born at Denison; state votes Republican 2d time in its history. Gulf Freeway, Houston-Galveston superhighway, opened. San Antonio makes large annexation, 80 square miles.
1953—About 100 killed by tornadoes; Waco hard hit. Texas Turnpike Authority created; Dallas-Fort Worth pike studied. Pres. Eisenhower signs bill giving Texas title to offshore oil; with president of Mexico he dedicates Falcon Dam on Rio Grande. Oveta Culp Hobby, former Women's Army Corps (WAC) director, born in Killeen (1905), becomes 1st secy. of health, education, and welfare.
1954—Severe drought, begun 1949, culminates in worst dust storms since Dust Bowl period of mid-30's. Record flood of Rio Grande occurs.

TEXAS

COUNTIES

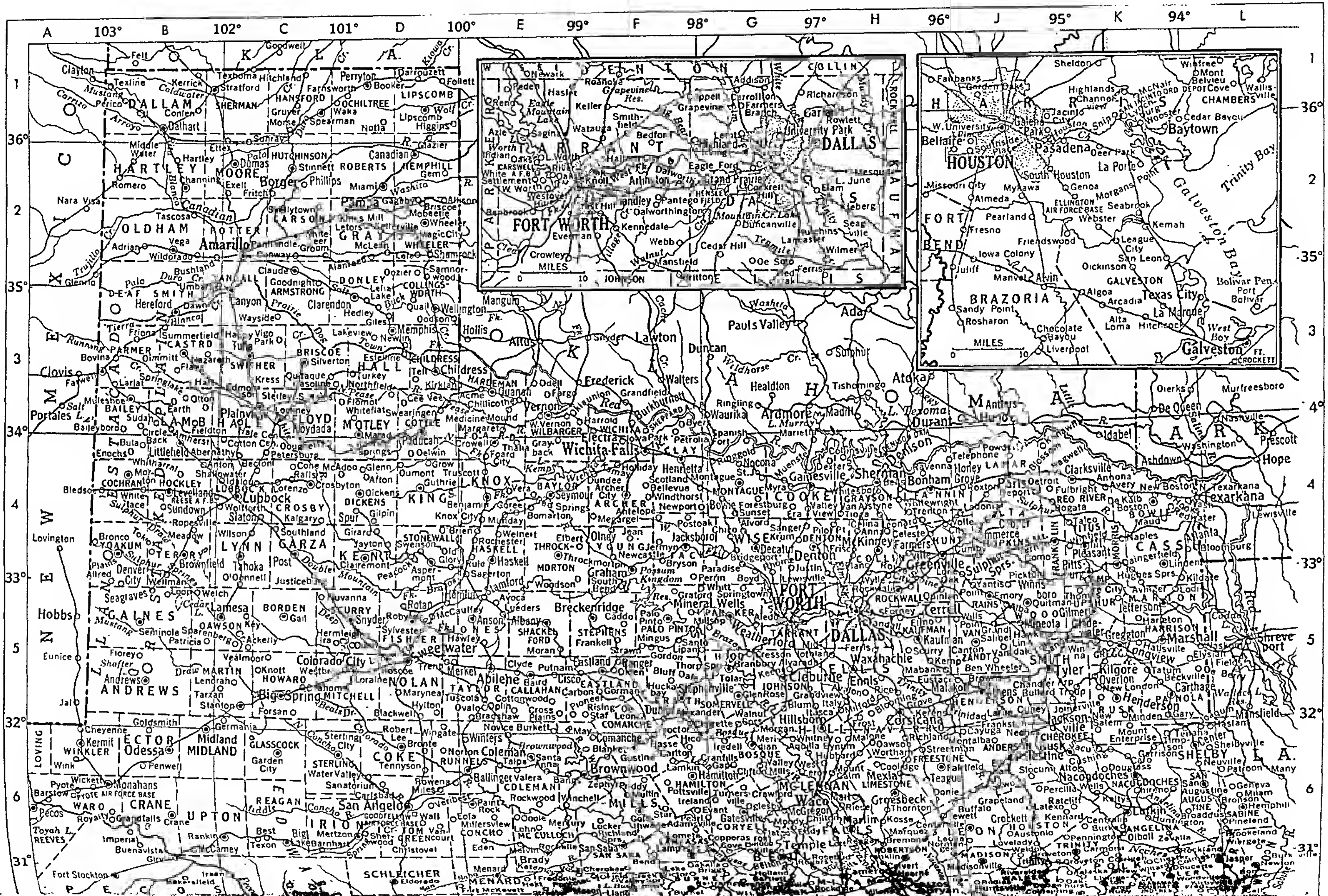
Anderson	31,875	J 6
Andrews	5,002	B 5
Angelina	36,032	K 6
Aransas	4,252	H 10
Archer	6,816	F 4
Armstrong	2,215	C 3
Atascosa	20,048	F 9
Austin	14,663	H 8
Bailey	7,592	B 3
Bandera	4,410	E 8
Bastrop	19,622	G 7
Baylor	6,875	E 4
Bee	18,174	G 9
Bell	73,824	G 6
Bexar	500,460	F 8
Blanco	3,780	F 7
Borden	1,106	C 5
Bosque	11,836	G 6
Bowie	61,966	K 4
Brazoria	46,549	J 3
Brazos	38,390	H 7
Brewster	7,309	D 12
Briscoe	3,528	C 3
Brooks	9,195	F 11
Brown	28,607	F 6
Burleson	13,000	H 7
Burnet	10,356	F 7
Caldwell	19,350	G 8
Calhoun	9,222	H 9
Callahan	9,087	E 5
Cameron	125,170	G 11
Camp	8,740	K 5
Carson	6,852	C 2
Cass	26,732	K 4
Castro	5,417	B 3
Chambers	7,871	L 1
Cherokee	38,694	J 6
Childress	12,123	D 3
Clay	9,896	F 4
Cochran	5,928	B 4
Coke	4,045	D 6
Coleman	15,503	E 6
Collin	41,692	H 4
Collingsworth	9,139	D 3
Colorado	17,576	H 8
Comal	16,357	F 8
Comanche	15,516	F 5
Concho	5,078	E 6
Cooke	22,146	G 4
Coryell	16,284	G 6
Cottle	6,099	D 3
Crane	3,965	B 6
Crockett	3,981	C 7
Crosby	9,582	C 4
Culberson	1,825	C 11
Dallam	7,640	B 1
Dallas	614,799	G 2
Dawson	19,113	C 5
De Witt	22,973	G 9
Deaf Smith	9,111	B 3
Delta	8,964	J 4
Denton	41,365	G 4
Dickens	7,177	D 4
Dimmit	10,654	E 9
Donley	6,216	D 2
Duval	15,643	F 10
Eastland	23,942	F 5
Ector	42,102	B 6
Edwards	2,908	D 7
El Paso	194,968	A 10
Ellis	45,645	H 5
Erath	18,434	F 5
Falls	26,724	H 6
Fannin	31,253	H 4
Fayette	24,176	H 8
Fisher	11,023	D 5
Floyd	10,535	C 3
Foard	4,216	E 3
Fort Bend	31,056	J 2
Franklin	6,257	J 4
Freestone	15,696	H 6
Frio	10,357	E 9
Gaines	8,909	B 5
Galveston	113,066	K 3
Garza	6,281	C 4
Gillespie	10,520	F 7
Glasscock	1,089	C 6
Goliad	6,219	G 9
Gonzales	21,164	G 8
Gray	24,728	D 2
Grayson	70,467	H 4
Gregg	61,258	K 5
Grimes	15,135	J 7
Guadalupe	25,392	G 8
Hale	28,211	C 3
Hall	10,930	D 3
Hamilton	10,660	F 6
Hansford	4,202	C 1
Hardeman	10,212	E 3
Hardin	19,535	K 7
Harris	806,701	J 1
Harrison	47,745	K 5
Hartley	1,913	B 2
Haskell	13,736	E 4
Hays	17,840	F 7
Hemphill	4,123	D 2
Henderson	23,405	J 5
Hidalgo	160,446	F 11
Hill	31,282	G 5
Hockley	20,407	B 4
Hood	5,287	G 5
Hopkins	23,490	J 4
Houston	22,825	J 6
Howard	26,722	C 5
Hudspeth	4,298	B 10
Hunt	42,731	H 4
Hutchinson	31,580	C 2
Irion	1,590	C 6
Jack	7,755	F 4
Jackson	12,916	H 9
Jasper	20,049	K 7
Jeff Davis	2,090	C 11
Jefferson	195,083	K 8
Jim Hogg	5,389	F 11
Jim Wells	27,991	F 10
Johnson	31,390	G 5
Jones	22,147	E 5
Karnes	17,139	G 9
Kaufman	31,170	H 5
Kendall	5,423	F 8
Kenedy	632	G 11
Kent	2,249	D 4
Kerr	14,022	E 7
Kimble	4,619	E 7
King	870	D 4
Kinney	2,668	D 8
Kleberg	21,991	G 10
Knox	10,082	E 4
La Salle	7,485	E 9
Lamar	43,033	J 4
Lamb	20,015	B 3
Lampasas	9,929	F 6
Lavaca	22,159	H 8
Lee	10,144	H 7
Leon	12,024	J 6
Liberty	26,729	K 7
Limestone	25,251	H 6
Lipscomb	3,658	D 1
Live Oak	9,054	F 9
Llano	5,377	F 7
Loving	227	D 10
Lubbock	101,048	C 4
Lynn	11,030	C 4
Madison	7,996	J 6
Marion	10,172	K 5
Martin	5,541	C 5
Mason	4,945	E 7
Matagorda	21,559	H 9
Maverick	12,292	D 9
Mc Culloch	11,701	E 6
Mc Lennan	130,194	G 6
Mc Mullen	1,187	F 9
Medina	17,013	E 8
Menard	4,175	E 7
Midland	25,785	B 6
Milam	23,585	H 7
Mills	5,999	F 6
Mitchell	14,357	D 5
Montague	17,070	G 4
Montgomery	24,504	J 7
Moore	13,349	C 2
Morris	9,433	K 4
Motley	3,963	D 3
Nacogdoches	30,326	K 6
Navarro	39,916	H 5
Newton	10,832	L 7
Nolan	19,808	D 5
Nueces	165,471	G 10
Ochiltree	6,024	D 1
Oldham	1,672	B 2
Orange	40,567	L 7
Palo Pinto	17,154	F 5
Panola	19,250	K 5
Parker	21,528	G 5
Parmer	5,787	B 3
Pecos	9,939	B 7
Polk	16,194	K 7
Potter	73,366	C 2
Presidio	7,354	C 12
Rains	4,266	J 5
Randall	13,774	C 2
Reagan	3,127	C 6
Real	2,479	E 8
Red River	21,851	J 4
Reeves	11,745	D 11
Refugio	10,113	G 9
Roberts	1,031	D 2
Robertson	19,908	H 6
Rockwall	6,156	H 5
Runnels	16,771	E 6
Rusk	42,348	K 5
Sabine	8,568	L 6
San Augustine	8,837	K 6
San Jacinto	7,172	J 7
San Patricio	35,842	G 10
San Saba	8,666	F 6
Schleicher	2,852	D 7
Scurry	22,779	D 5
Shackelford	5,001	E 5
Shelby	23,479	K 6
Sherman	2,443	C 1
Smith	74,701	J 5
Somervell	2,542	G 5
Starr	13,948	F 11
Stephens	10,597	F 5
Sterling	1,282	C 6
Stonewall	3,679	D 4
Sutton	3,746	D 7
Swisher	8,249	C 3
Tarrant	361,253	F 2
Taylor	63,370	E 5
Terrell	3,189	B 7
Terry	13,107	B 4
Throckmorton	3,618	E 4
Titus	17,302	K 4
Tom Green	58,929	D 6
Travis	160,980	G 7
Trinity	10,040	J 6
Tyler	11,292	K 7
Upshur	20,822	K 5
Upton	5,307	B 6
Uvalde	16,015	E 8
Val Verde	16,635	C 8
Van Zandt	22,593	J 5
Victoria	31,241	H 9
Walker	20,163	J 7
Waller	11,961	J 8
Ward	13,346	A 6
Washington	20,542	H 7
Webb	56,141	E 10
Wharton	36,077	H 8
Wheeler	10,317	D 2
Wichita	98,493	F 3
Wilbarger	20,552	E 3
Willacy	20,920	G 11
Williamson	38,853	G 7
Wilson	14,672	F 8
Winkler	10,064	A 6
Wise	16,141	G 4
Wood	21,308	J 5
Yoakum	4,339	B 4
Young	16,810	F 4
Zapata	4,405	E 11
Zavala	11,201	E 9

CITIES AND TOWNS

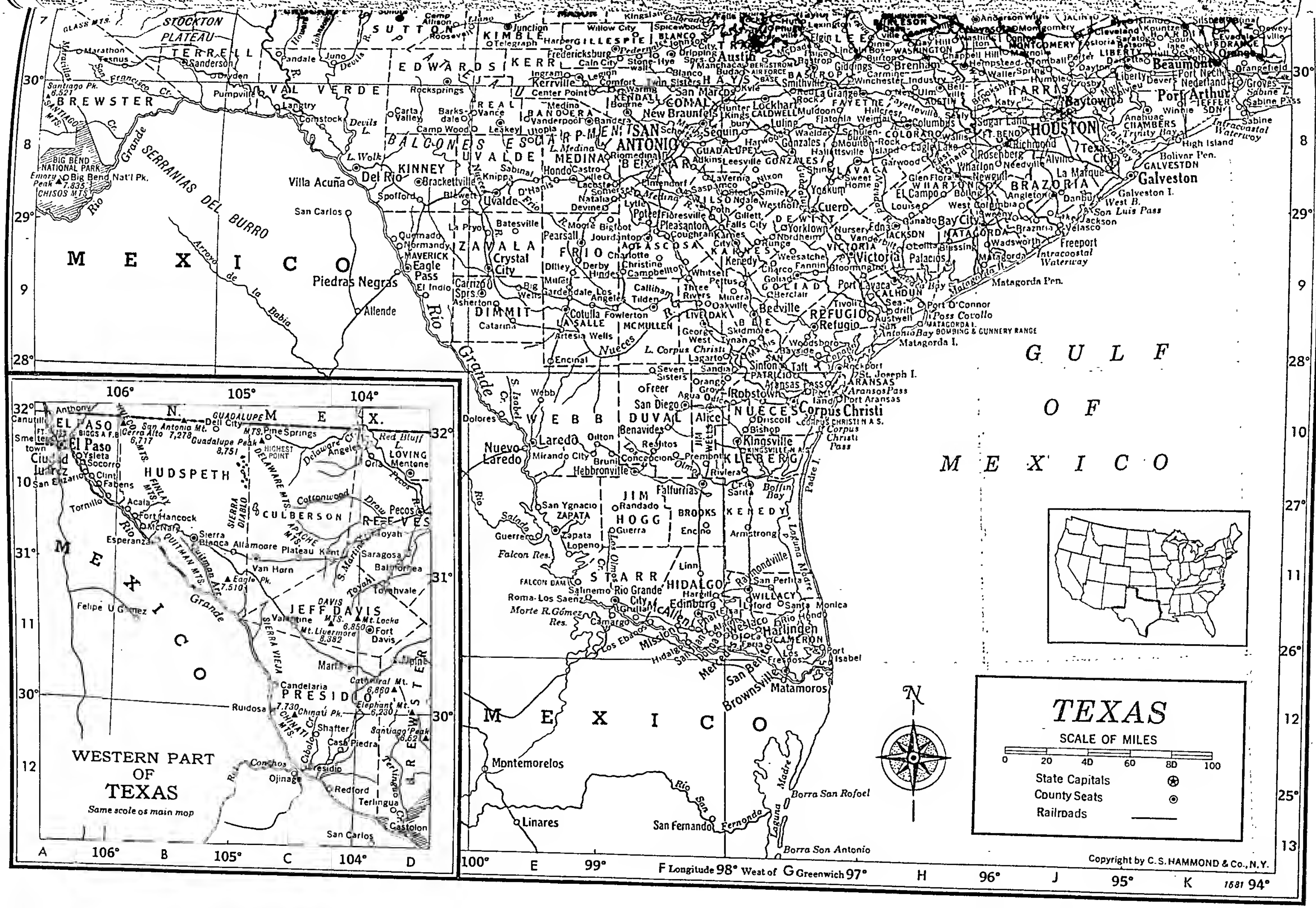
Abbott	345	H 6
Abernathy	1,692	B 4
Abilene	45,570	E 5
Acala	150	B 10
Ackerly	550	C 5
Acme	200	E 3
Adamsville	300	F 6
Addison	258	G 1
Adkins	20	F 8
Adrian	205	B 2
Afton	115	D 4
Agua Dulce	660	F 10
Alamo	3,017	F 11
Alamo Hts.	8,000	*F 8
Alanreed	200	D 2
Alba	547	J 5
Albany	2,241	E 5
Aledo	260	G 5
Alexander	96	F 5
Algoa	250	K 3
Alice	16,449	F 10
Allamoore	50	C 11
Allison	150	D 2
Allred	30	B 4
Almeda	1,800	J 2
Alpine	5,261	D 11
Alta Loma	1,400	K 3
Alto	1,021	J 6
Alvarado	1,656	G 5
Alvin	3,701	J 3
Alvord	735	G 4
Amarillo	74,246	C 2
Amherst	922	B 4
Anahuac	1,284	K 8
Anderson	500	J 7
Andrews	3,294	B 5
Angeles		C 10
Angleton	3,399	J 8
Anna	525	H 4
Annona	392	K 4
Anson	2,708	E 5
Antelope	125	F 4
Anthony	1,200	A 10
Anton	934	B 4
Aquilla	450	G 6
Aransas Pass	5,396	G 10
Arcadia	865	K 3
Archer City	1,901	K 4
Arlington	7,692	F 2
Armstrong	97	G 11
Arp	909	J 5
Artesia Wells	200	E 9
Asherton	2,425	E 9
Aspermont	1,062	D 4
Athens	5,194	J 5
Atlanta	3,782	K 4
Aubrey	491	*H 4
AUSTIN	132,459	G 7
Austonio		J 6
Austwell	228	H 9
Avalon	400	H 5
Avery	442	K 4
Avinger	546	K 5
Avoca	210	E 5
Azle	1,700	E 1
Bagwell	400	J 4
Bailey	198	*H 4
Baileyboro	50	B 3
Baird	1,821	E 5
Bakersfield	150	B 7
Balconcs Hts.	376	*F 8
Ballinger	5,302	E 6
Balmorhea	500	D 11
Bandera	1,036	F 8
Bangs	935	E 6
Bardwell	229	*H 5
Barksdale	300	D 8
Barnhart	357	C 6
Barstow	683	A 6
Bartlett	1,727	G 7
Bastrop	3,176	G 7
Batesville	500	E 9
Batson	800	K 7
Bay City	9,427	H 9
Bayside	300	G 9
Baytown	22,983	L 2
Beaumont	94,014	K 7
Beckville	550	K 5
Becton	50	C 4
Bedford	150	F 2
Bedias	575	J 7
Beeville	9,348	G 9
Belcherville	31	*G 4
Bellaire	10,173	J 2
Bellevue	418	F 4
Bells	614	H 4
Bellville	2,112	H 8
Belton	6,246	G 7
Ben Wheeler	400	J 5
Benavides	3,016	F 10
Benbrook	617	E 2
Bend	228	F 7
Benjamin	530	E 4
Berclair	300	G 9
Bertram	900	F 7
Bessmay	1,800	L 7
Best	26	C 6
Beverly Hills	701	*G 6
Big Ben Nat'l Pk.		A 8
Big Lake	2,152	C 6
Big Sandy	689	J 5
Big Spring	17,286	C 5
Big Wells	1,077	E 9
Bigfoot	150	F 9
Bishop	2,731	G 10
Blackwell	600	D 5
Blanco	718	F 7
Blanket	361	F 6
Bledsoe	105	A 4
Blessing	600	H 9
Blewett	200	D 8
Bloomburg	477	L 4
Blooming Grove	736	H 5
Bloomington	1,500	H 9
Blossom	780	J 4
Blue Ridge	306	H 4
Bluff Dale		F 5
Blum	368	G 5
Boerne	1,802	F 8
Bogata	936	J 4
Boling	1,200	H 8
Bomarton	300	E 4
Bon Wier	1,200	L 7
Bonham	7,049	H 4
Booker	619	D 1
Borger	18,059	C 2
Boston	200	K 4
Bovina	612	A 3
Bowie	4,544	G 4
Boyd	550	G 4
Brackettville	1,858	D 8
Bradshaw	105	E 5
Brady	5,944	E 6
Brandon	180	*H 5
Brazoria	776	J 9
Breckenridge	6,610	F 5
Bremond	1,141	H 6
Brenham	6,941	H 7
Bridgeport	2,049	G 4
Briggs		F 7
Briscoe	100	D 2
Britton	138	F 3
Broaddus	150	K 6
Bronco	42	B 4
Bronson	250	L 6
Bronte	1,020	D 6
Brookeland	350	L 6
Brookshire	1,015	J 8
Brownfield	6,161	B 4
Brownsboro	518	J 5
Brownsville	36,066	G 12
Brownwood	20,181	F 6
Bruni	700	F 10
Bryan	18,102	H 7
Bryson	588	F 4
Buckholts	700	H 7
Buda	483	G 7
Buenavista		B 6
Buffalo	970	J 6
Bula		B 4
Bullard	317	J 5
Buna		L 7
Burkburnett	4,555	F 3
Burke	500	K 6
Burkett	225	E 5
Burkeville	500	L 7
Burleson	791	*G 5
Burnet	2,394	F 7
Burton	510	H 7
Bushland	80	B 2
Byers	542	F 3
Bynum	325	H 6
Caddo		F 5
Caddo Mills	509	*H 4
Cain City	32	E 7
Caldwell	2,109	H 7
Call	1,500	L 7
Callibam	160	F 9
Calvert	2,548	H 7
Cameron	5,052	H 7
Camp Allison		D 7
Camp Ruby	100	K 7
Camp Wood	785	D 8
Campbellton	368	F 9
Canadian	2,700	D 2
Candelaria	250	C 12
Canton	881	J 5
Canutillo	1,326	A 10
Canyon	4,364	C 3
Carbon	444	F 5
Carlsbad		D 6
Carlton	250	F 6
Carmine	495	H 7
Carmona	300	K 6
Caro	220	K 6
Carrizo Sprs.	4,316	E 9
Carrollton	1,610	G 1
Carta Valley		D 8
Carthage	4,750	K 5
Casa Piedra	50	C 12
Castolon	20	D 13
Castroville	985	E 8
Catarina	380	E 9
Cayuga	1,200	J 6
Cedar Bayou	1,000	L 2
Cedar Hill	732	G 2
Cee Vee	27	D 3
Celeste	729	H 4
Celina	1,051	H 4
Cement		G 2
Center	4,323	K 6
Center Pt.	900	E 8
Centerville	961	H 6
Centralla	130	K 6
Chandler		J 5
Channelview	12,000	K 1
Channing	400	B 2
Cbappell Hill	500	H 7
Charco	135	G 9
Charlotte	1,272	F 9
Cherokee	311	F 7
Chester	700	K 7
Cheyenne	10	B 6
Chico	850	G 4
Childress	7,619	D 3
Chillicotbe	1,415	E 3
Chilton		H 6
Chireno	500	K 6
Chocolate Bayou	50	J 3
Chriesman	100	H 7
Christine	289	F 9
Christoval	650	D 6
Circle Back		B 3
Cisco	5,230	E 5
Clairemont	130	D 4
Clairette	100	G 5
Clarendon	2,577	C 3
Clarksville	4,353	K 4
Claude	820	C 2
Cleburne	12,905	G 5
Cleveland	5,183	K 7
Clifton	1,837	G 6
Clint		A 10
Clyde	908	E 5
Coahoma	802	C 5
Cockrell Hill	2,207	G 2
Coldspring		J 7
Coleman	6,530	E 6
College Sta.	7,925	H 7
Collinsville	561	H 4
Colmesneil	750	K 7
Colo. City	6,774	C 5
Columbus	2,878	H 8
Comanche	3,840	F 6
Comfort	1,200	F 7
Commerce	5,889	J 4
Como	356	J 4
Comstock	300	C 8
Concepcion		F 10
Cone	105	C 4
Conlen	40	B 1
Conroe	7,298	J 7
Conway	75	C 2
Coolidge	1,062	H 6
Cooper	2,350	J 4
Coppell	250	F 1
Copperas Cove	1,052	G 6
Corpus Christi	108,287	G 10
Corrigan	1,417	K 7

Corsicana	19,211	H 5
Cotton Center	45	C 4
Cottonwood	175	E 5
Cotulla	4,418	E 9
Coughran	50	F 9
Cove	50	L 1
Crandall	727	H 5
Crane	2,154	B 6
Cranfills Gap	435	G 6
Crawford	423	G 6
Cresson	355	G 5
Crockett	5,932	J 6
Crosby		J 8
Crosbyton	1,879	C 4
Cross Plains	1,305	E 5
Crowell	1,912	E 4
Crowley	300	E 2
Crystal City	7,198	E 9
Cuero	7,498	G 8
Cumby	504	J 4
Cuney	500	J 5
Cushing	479	J 6
Daingerfield	1,668	K 4
Daisetta	1,764	K 7
Dalhart	5,918	B 1
Dallas	434,462	H 2
Dalworth Park		F 2
Dalworthington	267	F 2
Danbury	700	J 8
Darrouzett	328	D 1
Davilla	300	G 7
Dawn	75	B 3
Dawson	1,107	H 6
Dayton	1,820	J 7
De Berry	475	L 5
De Kalb	1,928	K 4
De Leon	2,241	F 5
De Soto	298	G 2
Deanville	175	H 7
Decatur	2,922	G 4
Deer Park	736	K 2
Del Rio	14,211	D 8
Dell City		C 10
Delwin	23	D 4
Denison	17,504	H 4
Denton	21,372	G 4
Denver City	1,855	B 4
Deport	734	J 4
Derby	400	E 9
Detroit	679	J 4
Devers	700	K 8
Devine	1,672	E 8
Deweyville		L 7
Dexter	50	H 4
D'Hanis	1,000	E 8
Diboll	2,391	K 6
Dickens	420	D 4
Dickinson	2,704	K 3
Dilley	1,809	E 9
Dime Box	700	H 7
Dimmitt	1,461	B 3
Dodd City	329	*H 4
Dodge	350	J 7
Dodson	336	D 3
Dolores	20	E 10
Donie	300	H 6
Donna	7,171	F 11
Doole		E 6
Doucette	300	K 7
Dougherty	100	C 4
Douglass	400	K 6
Dozier	34	D 2
Dripping Sprs.	150	F 7
Driscoll	700	G 10
Dryden	210	C 7
Dublin	2,761	F 5
Dumas	6,127	C 2
Dumont	65	D 4
Duncanville	841	G 2
Dundee	146	F 4
Dunn	66	D 5
Eagle Ford	4,679	G 2
Eagle Lake	2,787	H 8
Eagle Pass	7,276	D 9
Earth	539	B 3
East Bernard	900	H 8
Eastland	3,626	F 5
Easton	203	*K 5
Ector	430	*H 4
Edcouch	2,925	*H 11
Eddy	450	G 6
Eden	1,993	E 6
Edgewood	834	*J 5
Edinburg	12,383	F 11
Edmonson	82	C 3
Edna	3,855	H 9
El Campo	6,237	H 8
El Indio	150	D 9
El Paso	130,485	A 10
Elam	500	H 2
Elbert	75	E 4
Eldorado	1,663	D 7
Electra	4,970	F 4
Elgin	3,168	G 7
Elkhart	776	J 6
Ellinger	219	*H 8
Elmendorf	500	F 8
Elmo	150	H 5
Elsa	3,179	G 11
Elysian Fields	305	L 5
Emhouse	198	*H 5
Emory	648	J 5
Encinal	1,071	E 9
Encino	500	F 11
Enloe	186	*J 4
Ennis	7,815	H 5
Enochs		B 4
Eola		E 6
Era	175	G 4
Esperanza	200	B 11
Estelline	464	D 3
Etter	30	B 2
Eustace	700	H 5
Evadale	500	L 7
Evant	500	G 6
Everman	451	E 2
Exell	300	C 2
Fabens	3,089	A 10
Fairbanks	730	J 1
Fairfield	1,742	H 6
Falfurrias	6,712	F 10
Falls City	422	G 9
Fannin	110	G 9
Fargo	50	E 3
Farmers Branch	915	G 1
Farmersville	1,955	H 4
Farnsworth	150	C 1
Farwell	500	A 3
Fate	141	*H 5
Fayetteville	462	H 8
Ferris	1,735	G 2
Field Creek	80	F 7
Fieldton	70	B 3
Flagg	25	B 3
Flat	350	G 6
Flatonia	1,098	G 8
Flomot	200	D 3
Florence	561	G 7
Floresville	1,949	F 9
Florey	5	B 5
Floydada	3,210	C 3
Fluvanna	205	D 5
Foard City	20	E 4
Follett	540	D 1
Forest Hill	1,519	F 2
Forestburg	200	G 4
Forney	1,425	H 5
Forsan	500	C 5
Fort Davis	1,200	D 11
Ft. Hancock	1,000	B 11
Ft. McKavett		E 7
Ft. Stockton	4,444	A 7
Ft. Worth	278,778	E 2
Fostoria	950	J 7
Fowlerton	300	F 9
Frankell	27	F 5
Franklin	1,209	H 6
Frankston	1,050	J 5
Fred	500	K 7
Fredericksburg	3,854	E 7
Fredonia	200	E 7
Freeport	6,012	J 9
Freer	2,280	F 10
Fresno	500	J 2
Friendswood	400	J 2
Friona	1,202	B 3
Frisco	736	H 4
Fritch		C 2
Frost	585	H 5
Fruitdale	876	*G 2
Fulbright	150	J 4
Gageby	10	D 2
Gail	70	C 5
Gainesville	11,246	G 4
Galena Park	7,186	J 1
Galveston	66,568	L 3
Ganado	1,258	H 8
Garden City	274	C 6
GardenOaks	25,000	J 1
Gardendale	45	E 9
Garland	10,571	H 1
Garrison	699	K 6
Garwood	975	H 8
Gary	475	K 5
Gasoline	25	C 3
Gatesville	3,856	G 6
Gause	500	H 7
Gay Hill	125	H 7
Gem	3	D 2
Geneva	125	L 6
Genoa	500	K 2
George West	1,533	F 9
Georgetown	4,951	G 7
Germania	35	C 5
Giddings	2,532	H 7
Giles	25	D 3
Gillett		G 8
Gilmer	4,096	J 5
Gilpin	30	D 4
Girard	450	D 4
Girvin	35	B 6
Gladewater	5,305	K 5
Glazier	107	D 2
Glen Flora	650	H 8
Glen Rose	1,254	G 5
Glenn	25	D 4
Godley	424	*G 5
Goldsmith	1,200	B 5
Goldthwaite	1,566	F 6
Goliad	1,584	G 9
Gonzales	5,659	G 8
Goodnight	100	C 3
Gordon	404	F 5
Goree	640	E 4
Gorman	1,317	F 5
Graford	655	F 5
Graham	6,742	F 4
Granbury	1,683	G 5
Grand Prairie	14,594	G 2
Grand Saline	1,810	J 5
Grandfalls	995	B 6
Grandview	886	G 5
Granger	1,637	G 7
Grapeland	1,358	J 6
Grapevine	1,824	F 1
Grayback	100	E 4
Grayburg	500	K 7
Greenville	14,727	H 4
Greggton	2,168	K 5
Griffing Park	2,096	*K 8
Groesbeck	2,182	H 6
Groom	678	C 2
Groves	12,000	L 8
Groveton	805	J 6
Grow	23	D 4
Grulla	1,013	F 11
Gruver	813	C 1
Guerra	115	F 11
Gunter	463	*H 4
Gustine	421	F 6
Guthrie	200	D 4
Hale Center	1,626	C 4
Hallettsville	2,000	G 8
Hallsville	617	K 5
Haltom City	5,760	F 2
Hamilton	3,077	G 6
Hamlin	3,569	E 5
Handley		F 2
Happy	690	C 3
Hargill	900	F 11
Harleton	350	K 5
Harlingen	23,229	G 11
Harper	360	E 7
Harrold	250	F 3
Hart	500	B 3
Hartley	425	B 2
Harwood	157	G 8
Haskell	3,836	E 4
Haslam		L 6
Haslet	180	F 1
Hasse	400	F 6
Hawkins	493	J 5
Hawley	325	E 5
Hearne	4,872	H 7
Hebbronville	4,302	F 10
Hedley	588	D 3
Hemphill	972	L 6
Hempstead	1,395	J 7
Henderson	6,833	K 5
Henrietta	2,813	F 4
Hereford	5,207	B 3
Hermleigh	671	D 5
Hext		E 7
Hico	1,212	F 6
Hidalgo	560	F 11
Higgins	675	D 1
High Island	1,000	K 8
Highland Pk.	11,405	G 2
Highlands	2,723	K 1
Hillcrest	2,826	H 8
Hillsboro	8,363	G 5
Hindes	123	F 9
Hitchcock	1,105	K 3
Hitchland	25	C 1
Holland	674	G 7
Holliday	1,007	F 4
Hondo	4,188	E 8
Honey Grove	2,340	J 4
Honey Island	1,250	K 7
Hooks	2,319	K 4
Houston	596,163	J 2
Howe	572	*H 4
Hubbard	1,768	H 6
Huckabay	130	F 5
Hughes Sprs.	1,445	K 5
Hull	1,200	K 7
Humble	1,388	J 7
Hunter	150	G 8
Huntington	1,039	K 6
Huntsville	9,820	J 7
Hutchins	743	H 2
Hutto	529	G 7
Hye	85	F 7
Hylton	25	D 5
Idalou	1,014	C 4
Imperial	400	B 6
Indian Oaks	800	E 2
Industry	500	H 7
Ingram	600	E 7
Iola	500	H 7
Iowa Colony	642	J 2
Iowa Park	2,110	F 4
Ira	118	C 5
Iraan	1,196	B 7
Iredell	394	G 6
Ireland	100	F 6
Irving	2,621	G 2
Italy	1,185	H 5
Itasca	1,718	G 5
Jacinto City	6,856	*J 1
Jacksboro	2,951	F 4
Jacksonville	8,607	J 5
Jasper	4,403	L 7
Jayton	635	D 4
Jean	120	F 4
Jefferson	3,164	K 5
Jermyn	300	F 4
Jewett	598	H 6
Joaquin	579	L 5
Johnson City	648	F 7
Joinerville	500	J 5
Jourdanton	1,481	F 9
Juliff		J 3
Junction	2,471	E 7
Juno	50	C 7
Justiceburg	86	C 5
Justin	496	G 5
Kalgary		C 4
Kamay	500	F 4
Kanawha	300	J 4
Karnes City	2,588	G 9
Katemcy	85	E 7
Katy	849	J 8
Kaufman	2,714	H 5
Keene	1,200	G 5
Keller	800	F 1
Kellerville	250	D 2
Keltys	1,091	K 6
Kemah	1,000	K 2
Kemp	881	H 5
Kenedy	4,234	G 9
Kennard	550	J 6
Kennedale	1,046	F 2
Kent	93	C 11
Kerens	1,198	H 5
Kermit	6,912	B 6
Kerrick	20	B 1
Kerrville	7,691	E 7
Key	30	C 5
Kildare	350	K 5
Kilgore	9,638	K 5
Killeen	7,045	G 6
Kings Mill	250	D 2
Kingsbury	500	G 8
Kingsland	100	F 7
Kingsville	16,898	G 10
Kirbyville	1,150	K 7
Kirkland	250	D 3
Kirvin	152	H 6
Kleberg	925	H 2
Knippa	360	E 8
Knott	200	C 5
Knox City	1,489	E 4
Kosse	566	H 6
Kountze	1,651	K 7
Kress	350	C 3
Krum	450	G 4
Kyle	888	G 8
La Feria	2,952	G 11
La Grange	2,738	G 8
La Marque	7,359	K 3
La Porte	4,429	K 2
La Pryor	500	E 9
La Vernia		G 8
Lacoste	500	E 8
Ladonia	1,104	J 4
Lagarto	210	F 9
Lake Jackson	2,897	J 9
Lake June	1,517	H 2
Lake Victor	50	F 7
Lake Worth	2,351	E 2
Lakeview	287	D 3
Lakeview	3,091	*K 8
Lamesa	10,704	C 5
Lamkin	100	F 6
Lampasas	4,869	F 6
Lancaster	2,632	G 2
Langtry	135	C 8
Laredo	51,910	E 10
Lariat	50	B 3
Larue	75	J 5
Latexo	500	J 6
Lawn	311	*E 5
League City	1,341	K 2
Leakey	800	E 8
Leesville	285	G 8
Lefors	577	D 2
Legion	200	F 7
Lela	130	D 2
Lelia Lake	150	D 3
Lenorah	108	B 5
Leona	300	H 6
Leonard	1,211	H 4
Leroy	275	G 6
Letot		G 2
Levelland	8,264	B 4
Lewisville	1,516	G 5
Lexington	603	G 7
Liberty	4,163	K 7
Liberty Hill	700	F 7
Lincoln	103	H 7
Lindale	1,105	J 5
Linden	1,744	K 4
Linn	150	F 11
Lipan	650	F 5
Lipscomb	100	D 1
Littlefield	6,540	B 4
Liverpool	200	J 3
Livingston	2,865	K 7
Llano	2,954	F 7
Locker	70	F 6
Lockhart	5,573	G 8
Lockney	1,692	C 3
Lodi	190	K 5
Lohn		E 6
Lolita	268	H 9
Lometa	951	F 6
London	175	E 7
Lone Oak	571	H 5
Longview	24,502	K 5
Longworth	101	D 5
Loop	120	B 5
Lopeno	500	E 11
Loraine	1,045	D 5
Lorenzo	939	C 4
Los Angeles		F 9
Los Ebanos	300	F 11
Los Fresnos	1,113	G 11
Lott	956	H 6
Louise	700	H 8
Lovelady	541	J 6
Lubbock	71,747	C 4
Lueders	708	E 5
Lufkin	15,135	K 6
Luling	4,297	G 8
Lyford	1,473	G 11
Lynchburg		K 1
Lytle	1,000	F 8
Mabank	896	H 5
Madisonville	2,393	J 7
Magic City	25	D 2
Magnolia	525	J 7
Malakoff	1,286	H 5
Malone	352	H 6
Manchaca	200	G 7
Manor	820	G 7
Mansfield	964	F 2
Manvel	350	J 3
Marathon	800	A 7
Marble Falls	2,044	F 7
Marfa	3,603	C 12
Margaret	75	E 3
Marion	439	F 8
Marlin	7,099	H 6
Marquez	287	H 6
Marshall	22,327	K 5
Mart	2,269	H 6
Maryneal	150	D 5
Mason	2,456	E 7
Matador	1,335	D 3
Matagorda	700	J 9
Mathis	4,050	G 9
Maud	713	K 4
May		F 5
Maypearl	373	*H 5
McAdoo	108	C 4
McAllen	20,067	F 11
McCamey	3,121	B 6
McCaulley	200	E 5
McDade	400	G 7
McGregor	2,669	G 6
McKinney	10,560	H 4
McLean	1,439	D 2
McNair	1,313	K 1
McNary	250	B 11
Meadow	490	B 4
Medicine Mound	150	E 3
Medina	400	E 8
Megargel	347	F 4
Melvin	696	E 6
Memphis	3,810	D 3
Menard	2,685	E 7
Mentone	145	D 10
Mercedes	10,081	F 12
Mercury	100	E 6
Meridian	1,146	G 6
Merkel	2,338	E 5
Mertens	210	*H 5
Mertzon	768	C 6
Mesquite	1,696	H 2
Mexia	6,627	H 6
Miami	646	D 2
Middle Water	15	B 2
Midland	21,713	C 6
Midlothian	1,177	G 5
Milam	75	L 6
Milano	500	H 7
Miles	739	D 6
Milford	690	H 5
Millersview	200	E 6
Millett	300	E 9
Millsap	287	G 5
Minden	275	K 5
Mineola	3,626	J 5
Mineral	260	G 9
Mineral Hts.	552	*H 4
Mineral Wells	7,801	F 5
Mingus	310	F 5
Mirando City	800	E 10
Mission	10,765	F 11
Missouri City	150	J 2
Mobeetie	350	D 2

* No room on map for name.



FORT WORTH
DALLAS
HOUSTON
Galveston Bay
Trinity Bay
Baytown
Pasadena
La Porte
Texas City
Galveston
BRAZORIA
FORT BEND
MILES
Amarillo
Lubbock
Abilene
Wichita Falls
Big Spring
San Angelo
Odessa
Midland
Waco
Tyler
Texarkana
Sherman
Denison
Corsicana
Paris
Greenville
Lawton
Ardmore
Clovis
Hobbs
NEW MEXICO


TEXAS
SCALE OF MILES
0 20 40 60 80 100
State Capitals
County Seats
Railroads
GULF OF MEXICO
MEXICO
WESTERN PART OF TEXAS
Same scale as main map
Longitude 98° West of Greenwich 97°
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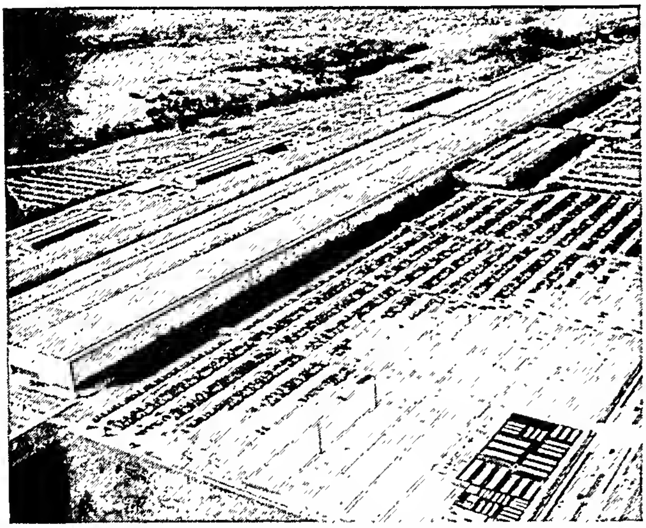
Monahans	6,311	B 6
Mont Belvieu	600	L 1
Montague	402	G 4
Montalba		J 6
Montgomery	800	J 7
Moody	1,084	G 6
Moore		E 9
Moran	610	E 5
Morgan	424	G 5
Morgans Pt.	656	K 2
Morse	150	C 1
Morton	2,274	B 4
Moulton	692	H 8
Mt. Calm	456	H 6
Mt. Enterprise	504	K 6
Mt. Pleasant	6,342	K 4
Mt. Vernon	1,433	J 4
Muenster	896	G 4
Muldoon	250	G 8
Muleshoe	2,477	B 3
Mullin	326	F 6
Munday	2,280	E 4
Mykawa	200	J 2
Myra	275	G 4
Nacogdoches	12,327	J 6
Naples	1,346	K 4
Nash	550	K 4
Natalia	1,175	F 8
Navasota	5,188	J 7
Nazareth	104	B 3
Neches	350	J 6
Nederland	3,805	K 8
Needville	609	J 8
Neuville	500	L 6
New Boston	2,688	K 4
New Braunfels	12,210	F 8
New London	1,800	K 5
New Salem	250	K 6
New Ulm	400	H 8
New Waverly	500	J 7
New Willard	500	K 7
Newark	295	E 1
Newcastle	743	F 4
Newgulf	1,803	J 8
Newlin		D 3
Newport	256	F 4
Newton	929	L 7
Nixon	1,875	G 8
Nocona	3,022	G 4
Nordheim	477	G 9
Normandy	350	D 9
Normangee	657	H 6
N. Pleasanton	832	*F 9
N. Texarkana	1,328	L 4
Northfield	150	D 3
Norton	100	E 6
Notla	5	D 1
Novice	252	E 5
Nursery	200	H 9
Oak Knoll	3,930	F 2
Oakalla		F 7
Oakhurst	500	J 7
Oakville	400	G 9
Oakwood	759	J 6
O'Brien	550	E 4
Odell	238	E 3
Odem	1,680	*G 10
Odessa	29,495	B 6
O'Donnell	1,473	C 4
Oglesby	450	G 6
Oilton	500	F 10
Oklaunion	129	E 3
Old Glory	125	D 4
Olden	500	F 5
Olmos Park	2,841	*F 8
Olney	3,765	F 4
Olton	1,201	B 3
Omaha	735	*K 4
Onalaska	200	J 7
Oplin	50	E 5
Orange	21,174	L 7
Orange Grove	935	F 10
Orangefield	1,500	L 7
Ore City	342	K 5
Orla		D 10
Ovalo	161	E 5
Overton	2,001	K 5
Ozona	2,885	C 7
Paducah	2,952	D 4
Paige	350	G 7
Paint Rock		E 6
Palacios	2,799	H 9
Palestine	12,503	J 6
Palmer	647	*H 5
Palo Pinto	500	F 5
Pampa	16,583	D 2
Pandale	50	C 7
Panhandle	1,406	C 2
Pantego	646	F 2
Paradise		G 5
Paris	21,643	J 4
Pasadena	22,483	K 2
Patricia	60	B 5
Patroon		L 6
Peacock	165	D 4
Pear Ridge	2,029	*K 8
Pearl	126	F 6
Pearland	1,250	J 2
Pearsall	4,481	E 9
Pecan Gap	319	*J 4
Pecos	8,054	D 10
Peden	200	E 1
Penelope	243	*H 6
Pennington	250	J 6
Penwell		B 6
Percilla	60	J 6
Perico	30	B 1
Perrin	387	G 5
Perryton	4,417	D 1
Petersburg	777	C 4
Petrolia	606	F 4
Pettus		G 9
Pflugerville	450	G 7
Pharr	8,690	F 11
Phillips	4,105	C 2
Pickton	673	J 4
Pilot Point	1,176	H 4
Pine Springs	2	C 10
Pineland	1,454	L 6
Pioneer	82	F 5
Pittsburg	3,142	J 4
Plains	470	B 4
Plainview	14,044	C 3
Plano	2,126	H 4
Plateau	20	C 11
Pleasanton	2,913	F 9
Point	450	J 5
Pontotoc	100	E 7
Port Aransas	551	H 10
Port Arthur	57,530	K 8
Port Bolivar	410	L 3
Port Isabel	2,372	G 11
Port Lavaca	5,599	H 9
Port Neches	5,448	K 7
Port O'Connor	600	H 9
Porter	840	J 7
Portland	1,292	G 10
Post	3,141	C 4
Postoak	8	F 4
Poteet	2,487	F 8
Poth	1,089	F 8
Pottsboro	383	*H 4
Pottsville	200	F 6
Powderly	380	J 4
Premont	2,619	F 10
Presidio	2,000	C 12
Priddy	300	F 6
Princeton	540	*H 4
Proctor	90	F 5
Prosper	243	*H 4
Pumpville	75	C 8
Purdon	203	*H 5
Putnam	289	E 5
Pyote		A 6
Quail	150	D 3
Quanah	4,589	E 3
Queen City	511	*K 4
Quemado		D 9
Quinlan	599	H 5
Quitaque	647	C 3
Quitman	927	J 5
Ralls	1,779	C 4
Randado		F 10
Ranger	3,989	F 5
Rankin	1,139	B 6
Ratcliff	250	J 6
Ravenna	185	H 4
Raymondville	9,136	G 11
Reagan		H 6
Realitos		F 10
Red Oak	400	G 3
Red Rock	97	G 8
Red Springs	95	E 4
Redford	297	C 12
Redwater	451	K 4
Refugio	4,666	G 9
Reno	300	E 1
Rhome	461	G 4
Rice	396	H 5
Richardson	1,289	H 1
Richland	308	H 6
Richland Sprs.	584	F 6
Richmond	2,030	J 8
Riesel	409	H 6
Ringgold		G 4
Rio Grande City	3,992	F 11
Rio Hondo	1,125	G 11
Riomedina	475	F 8
Rising Star	1,289	F 5
River Oaks	7,097	E 2
Riverside	300	J 7
Riviera	600	F 10
Roanoke	511	F 1
Roaring Sprs.	435	D 4
Robert Lee	1,069	D 5
Robstown	7,278	G 10
Roby	1,051	D 5
Rochelle	300	E 6
Rochester	773	E 4
Rock Island	435	H 8
Rockdale	2,321	G 7
Rockland	300	K 6
Rockport	2,266	H 9
Rocksprings	1,436	D 8
Rockwall	1,501	H 5
Rockwood	200	E 6
Rogers	948	G 6
Roma-Los Saenz	1,576	E 11
Romero	25	B 2
Roosevelt	200	D 7
Ropesville	391	B 4
Roscoe	1,584	D 5
Rosebud	1,730	G 6
Rosenberg	6,210	J 8
Rosharon	200	J 3
Rotan	3,163	D 5
Round Rock	1,438	G 7
Round Top	126	*H 8
Rowena	435	D 6
Rowlett	275	H 1
Roxton	1,000	J 4
Royalty		B 6
Royse City	1,266	H 4
Ruidosa	200	C 12
Rule	1,251	E 4
Runge	1,055	G 9
Rusk	6,598	J 6
Rye	185	K 7
Sabinal	1,974	E 8
Sabine	200	L 8
Sabine Pass	816	L 8
Sacul	700	J 6
Sagerton	102	E 4
Saginaw	561	E 2
Saint Joe	1,147	G 4
Salineno	400	E 11
Samnorwood	75	D 2
San Angelo	52,093	D 6
San Antonio	408,442	F 8
San Augustine	2,510	K 6
San Benito	13,271	G 12
San Diego	4,397	F 10
San Elizario	1,200	A 10
San Felipe	296	*H 8
San Juan	3,413	F 11
San Leon		K 2
San Marcos	9,980	F 8
San Perlita	200	G 11
San Saba	3,400	F 6
San Ygnacio	1,800	E 10
Sanatorium	1,275	D 6
Sanderson	2,049	B 7
Sandia	517	F 9
Sandy Point	100	J 3
Sanger	1,170	G 4
Sansom Park Village	1,611	*E 2
Santa Anna	1,605	E 6
Santa Monica	200	G 11
Santa Rosa	400	*G 11
Santo	350	F 5
Saragosa	200	D 11
Saratoga	1,500	K 7
Sarita	250	G 10
Saspamco	500	F 8
Savoy	314	*H 4
Schertz	2,350	F 8
Schulenburg	2,005	H 8
Scotland	400	F 4
Scurry	500	H 5
Seabrook	1,800	K 2
Seadrift	567	H 9
Seagoville	1,927	H 2
Seagraves	2,101	B 5
Sealy	1,942	H 8
Seguin	9,733	G 8
Seminole	3,479	B 5
Seven Sisters	350	F 9
Seymour	3,779	E 4
Shafter	259	C 12
Shallowater	500	B 4
Shamrock	3,322	D 2
Sheffield	350	B 7
Shelbyville		L 6
Sheldon	200	K 1
Shepherd		K 7
Sherman	20,150	H 4
Sherwood	247	D 6
Shiner	1,778	G 8
Shiro	300	J 7
Shoreacres	183	*J 8
Sierra Blanca	900	B 11
Silsbee	3,179	K 7
Silverton	857	C 3
Sinton	4,254	G 9
Skellytown	700	C 2
Skidmore	800	G 9
Slaton	5,036	C 4
Slocum	200	J 6
Smeltertown	3,500	A 10
Smiley	503	G 8
Smithfield	500	F 1
Smithville	3,379	G 7
Snyder	12,010	D 5
Socorro	1,200	A 10
Somerset	920	F 8
Somerville	1,425	H 7
Sonoma	210	*H 5
Sonora	2,633	D 7
Sourlake	1,630	K 7
South Bend	325	F 5
South Groveton		J 7
S. Houston	4,126	J 2
S. Plains	100	C 3
S. Texarkana	317	*K 4
Southland	210	C 4
Southside Pl.	1,436	J 2
Spanish Fort	203	G 4
Sparenberg		B 5
Spearman	1,852	C 1
Spicewood	125	F 7
Spofford	246	D 8
Spring	500	J 7
Springlake		B 3
Springtown	650	G 5
Spur	2,183	D 4
Stamford	5,819	E 5
Stanton	1,603	C 5
Star		F 6
Stephenville	7,155	F 5
Sterley	96	C 3
Sterling City	846	D 6
Stinnett	1,170	C 2
Stockdale	1,105	G 8
Stonewall	135	F 7
Stratford	1,385	C 1
Strawn	922	F 5
Streeter	26	E 7
Streetman	419	H 6
Sudan	1,348	B 3
Sugar Land	2,285	J 8
Sulphur Sprs.	8,991	J 4
Summerfield		B 3
Sundown	1,492	B 4
Sunray	1,530	C 1
Sunset		G 4
Swearingen	45	D 3
Sweeny	1,393	J 8
Sweet Home	500	H 8
Sweetwater	13,619	D 5
Swenson	175	D 4
Sylvester		D 5
Taft	2,978	G 9
Tahoka	2,848	C 4
Talco	917	K 4
Talpa	234	E 6
Tarzan	79	B 5
Tascosa	125	B 2
Tatum	599	K 5
Taylor	9,071	G 7
Teague	2,925	H 6
Tehuacana	389	*H 6
Telegraph	17	E 7
Telephone	275	J 4
Tell	100	D 3
Temple	25,467	G 6
Tenaha	715	K 6
Tennyson		D 6
Terlingua	20	D 12
Terrell	11,544	H 5
Terrell Hills	2,708	*F 8
Tesnus	8	B 7
Texarkana	24,753	L 4
Texas City	16,620	K 3
Texhoma	299	C 1
Texline	437	B 1
Texon	500	C 6
Thalia	223	E 4
Thomas	200	J 5
Thorndale	855	G 7
Thornton	623	H 6
Thorp Springs	200	F 5
Thrall	585	*G 7
Three Rivers	2,026	F 9
Throckmorton	1,320	F 4
Tilden	425	F 9
Timpson	1,455	K 6
Tioga	529	H 4
Tivoli	300	H 9
Tokio	200	B 4
Tolar	338	G 5
Tom Bean	286	*H 4
Tomball	1,065	J 7
Tornillo	400	A 10
Toyah	409	D 11
Toyahvale	16	D 11
Trent	296	D 5
Trenton	603	H 4
Trinidad	950	J 5
Trinity	2,054	J 7
Troup	1,539	J 5
Truscott	255	E 4
Tulia	3,222	C 3
Turkey	1,005	D 3
Turnersville	150	G 6
Tuscola	497	E 5
Twin Sisters	50	F 7
Tyler	38,968	J 5
Tynan	70	G 9
Umbarger	465	B 3
University Park	24,275	H 2
Utopia	350	E 8
Uvalde	8,674	E 8
Valentine	510	C 11
Valera	300	E 6
Valley Mills	1,037	G 6
Valley Spring		F 7
Valley View	500	H 4
Van	610	J 5
Van Alstyne	1,649	H 4
Van Horn	1,161	C 11
Vance	100	E 8
Vancourt	11	D 6
Vanderbilt	400	H 9
Vanderpool	150	E 8
Vealmoor	35	C 5
Vega	620	B 2
Velasco	2,260	J 9
Venus	357	*H 5
Vera	270	E 4
Veribest	33	D 6
Vernon	12,651	E 3
Victoria	16,126	H 9
Vigo Park		C 3
Village Mills	267	K 7
Voca	100	E 7
Voth	1,200	K 7
Waco	84,706	G 6
Wadsworth	250	J 9
Waelder	1,275	G 8
Waka	100	D 1
Wake	1,066	*K 4
Wall	200	D 6
Waller	715	J 7
Wallis	1,500	H 8
Wallisville	300	L 1
Walnut Springs	626	G 5
Waring	176	F 8
Washington	300	J 7
Waskom	719	L 5
Watauga	150	F 1
Water Valley	300	C 6
Waxahachie	11,204	H 5
Wayside	43	C 3
Weatherford	8,093	G 5
Webb	17	E 10
Webb	45	F 2
Webster		K 2
Weesatche	250	G 9
Weimar	1,663	H 8
Weinert	288	E 4
Welch		B 5
Weldon	250	J 6
Wellington	3,676	D 3
Wellman	165	B 5
Wells	718	J 6
Weslaco	7,514	G 11
West	2,130	G 6
W. Columbia	2,100	J 8
West University Place	17,074	J 2
West Vernon		E 3
West Worth	529	E 2
Westbrook	220	C 5
Westhoff	610	G 8
Westminster	192	*H 4
Westover Hills	266	E 2
Wharton	4,450	J 8
Wheeler	904	D 2
White Deer	629	C 2
White Settlement	10,827	E 2
Whiteface	579	B 4
Whiteflat	100	D 3
Whitesboro	1,854	H 4
Whitewright	1,372	H 4
Whitharral	275	B 4
Whitney	1,383	G 6
Whitsett	100	F 9
Whitt	150	G 5
Wichita Falls	68,042	F 4
Wickett		B 6
Wiergate	1,000	L 6
Wildorado	150	B 2
Willis	1,164	J 7
Willow City	75	F 7
Wills Point	2,030	J 5
Wilmer	465	H 2
Wilson	300	C 4
Winchell	100	E 6
Winchester	275	H 7
Windom	297	*H 4
Windthorst	400	F 4
Winfield	319	K 4
Winfree	50	L 1
Wingate	262	D 5
Wink	1,521	A 6
Winnie	800	K 8
Winnsboro	2,512	J 5
Winona	450	J 5
Winters	2,676	E 6
Wolfe City	1,345	J 4
Wolfforth	300	C 4
Woodsboro	1,836	G 9
Woodson	483	E 5
Woodville	1,863	K 7
Wooster	2,500	K 2
Wortham	1,170	H 6
Wylie	1,295	H 5
Yantis	300	J 5
Yoakum	5,231	G 8
Yorktown	2,596	G 9
Ysleta	4,782	A 10
Zapata	1,409	E 11
Zavalla	956	K 6
Zephyr		F 6

* No room on map for name.

AIRPLANES AND OIL—MODERN MANUFACTURES



This Fort Worth aircraft plant, one of the world's largest, has a long assembly line. The white stripes are used to test cameras.

The manufacture of oil-field machinery is one of the leading industries. Here rock bits pass inspection in a Houston plant.

The United States census of 1850—the first after annexation—gave Texas a population of 212,592. In 20 years it had increased to more than 818,000, and by 1950 it had risen to more than 7,700,000.

This great boom in population was predicted as early as the 1850's in a story told of Gen. Robert E. Lee. During a visit to Texas, Lee was thoughtfully gazing out over the prairies when one of his companions asked him, "What do you see?" "I'm listening to the footsteps of the coming millions," was Lee's answer. His prediction was more than fulfilled.

Even though Texas has had more immigrants than any other Southern state, the number of foreign born (except Mexican born) living in Texas is very small. Mexicans are thickly scattered along the Rio Grande and in South Texas. They labor throughout the cotton-raising area of the state. Negroes are most numerous in the south and east where they work in the cotton fields, on the farms, and in the cities.

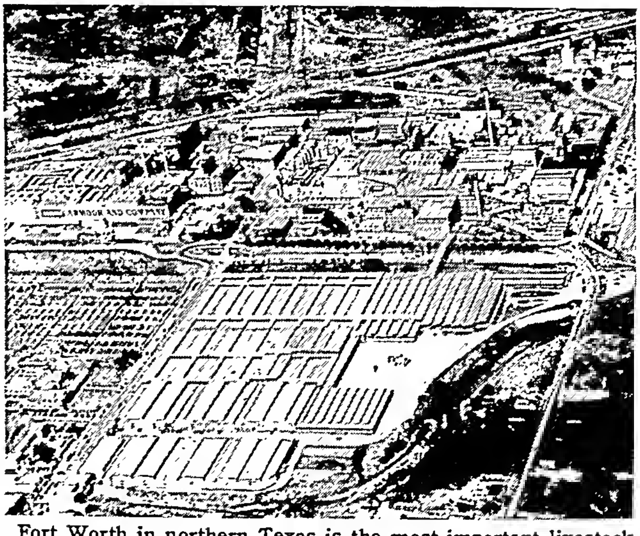
Among the cities which have a sizable Mexican population is Laredo on the Rio Grande, about 200 miles from the Gulf. This city has an interesting mixture of Spanish-type and American-type buildings.

Remarkable History of the State

While mapping the Gulf of Mexico in 1519, Alonso de Pineda sailed along the coast of Texas. Earliest of Europeans to penetrate Texas was Cabeza de Vaca, a Spanish noble, shipwrecked here. After years of wandering (1528-36) he reached Culiacán, Mexico. In 1541, Coronado crossed the Texas Panhandle in his search for the mythical Seven Cities of Cibola. For the next 120 years, occasional parties of Spaniards camped in the wilderness, but no settlements were started. For nearly 200 years after its discovery, the region did not have an official name and the boundaries were indefinite. In 1659 Franciscan fathers established a mission at Guadalupe, where El Paso now stands. Settlers from New Mexico fled hither in

MEAT ON THE HOOF AND IN THE PACKING PLANT

Texas is a year-round grazing land, with its mild winters. Here a Texas cowboy marks a calf with the brand of his ranch.



Fort Worth in northern Texas is the most important livestock market and meat-processing center of the state and of the South.

1680 during an Indian revolt, and the El Paso district was added to New Mexico. Later, other missions were built farther south along the Rio Grande.

Missing the mouth of the Mississippi, where he wished to start a colony, the French explorer La Salle sailed into Matagorda Bay in 1685. He pushed inland and built Fort St. Louis, which was wiped out by Indians in 1687. Fear of French influence hurried the Spanish into extending missions into east Texas among the Tejas. The state of Texas was probably named for this tribe or confederation of Indians. Two missions, built in 1690 by Father Massanet and Captain De Léon near the Neches, were soon abandoned but others replaced them after 1716.

Some 25 missions and a number of presidios, or military posts, were built in Texas before the 19th century. The missions failed to civilize the fierce Comanches and Apaches of the west and had no success with the gentler eastern Indians. They also failed to attract settlers. After more than 150 years of Spanish rule, the only centers of population were San Antonio, Goliad, and Nacogdoches. San Antonio, founded in 1718, was the Texas capital during the latter part of Spanish rule and through the Mexican regime. In 1723 Texas was made a province of New Spain. After the Louisiana Purchase in 1803, the United States regarded east Texas as its territory; but Spain refused to recognize the claim and was given undisputed control through the Adams-Onís Treaty (1819-21).

Austin, "the Father of Texas"

The gate to American colonists swung open, however, in 1821 when Moses Austin, a Connecticut Yankee, won Spain's consent to settle 300 families in Texas. Shortly after Austin's death, his able son, Stephen Fuller Austin, called "the father of Texas," brought the first American settlers to the lower Brazos in December 1821 (*see* Austin). Texas now flew the banner of Mexico, which had thrown off the Spanish yoke in the summer of that year. San Felipe de Austin was the capital of the American settlement after 1823. Its population increased very rapidly.

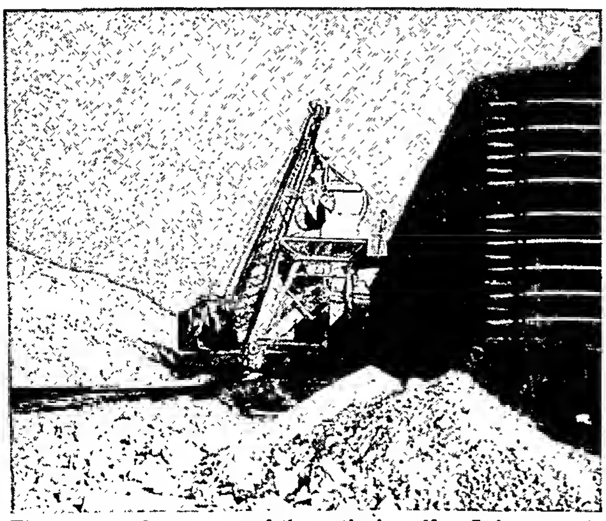
Mexico was friendly to Americans and made land grants to settlers. As immigration from the United States increased, however, Mexico grew more hostile. Resentment flared in 1826 when American promoters set up the short-lived Fredonian republic at Nacogdoches. By 1830 the population of Texas had risen to nearly 25,000 and further American immigration was forbidden. Disputes with Mexico increased. In 1835, after Santa Anna established a dictatorship over chaotic Mexico, the Texans revolted.

The New Republic of Texas

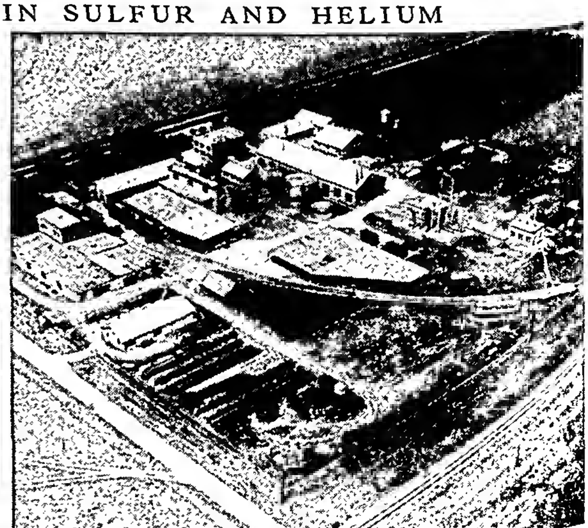
In hourly fear of hostile troops, pioneers met in convention at Washington on the Brazos, March 1, 1836. The declaration of independence from Mexico on March 2 charged that Mexico's rule was despotic and that the interests of Texas had been neglected. A constitution modeled after that of the United States was adopted for the new Republic of Texas.

The heroic but unsuccessful defense of the Alamo was the most striking event in the Texas war for independence. The Alamo was a rebuilt mission founded first in 1718. The Americans used it as a fort and had about 150 soldiers there. Several thousand Mexicans under Santa Anna began to bombard the fort Feb. 23, 1836. Seven days later, about 30 Americans crossed the Mexican lines to join the Alamo's defenders. The Mexicans stormed the fort on March 6. Hand-to-hand fighting followed. The American soldiers fulfilled their commander's pledge, "Victory or death"; not one survived. Among those killed were the frontiersman David Crockett, Col. James Bowie, for whom the bowie knife was named, and the commander, Lieut. Col. W. B. Travis. Later in the month, the Mexicans massacred more than 300 Texan prisoners at Goliad. "Remember the Alamo" and "Remember Goliad" became war cries of the Texans.

TEXAS IS UNEXCELLED IN SULFUR AND HELIUM



The state produces most of the nation's sulfur. It is pumped from wells, allowed to harden, and then loaded into freight cars.



The "Lone Star State" is the leading helium producer in the country. This plant is at Amarillo. Another installation is at Exell.

Independence was gained after Gen. Sam Houston defeated Santa Anna at San Jacinto in 1836 (*see* Houston, Samuel). Columbia was the republic's capital in 1836, Houston in 1837-39, and Austin in 1839-42. After Mexican raids on San Antonio, the archives were ordered returned to Houston. Citizens of Austin prevented their removal in the bloodless "archive war." In 1842-45 Washington on the Brazos was the capital.

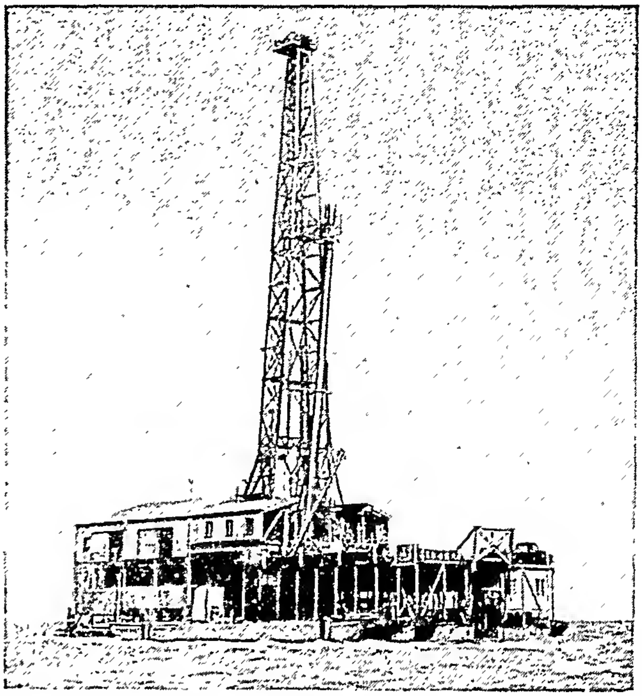
For ten troublous years Texas was a republic, recognized by foreign countries and the United States. It was hemmed in by the Indian frontier from the Rio Grande to the Red River and by the Mexican border along the Rio Grande. The emergency gave rise to the famous Texas Ranger, who could "ride like a Mexican, trail like an Indian, shoot like a Tennesseean, and fight like a very devil." The rangers, first in service about 1826, are the oldest state police force in the nation. They were reorganized in 1874 as both soldiers and peace officers, and in 1935 they were made a branch of the Department of Public Safety, charged with enforcing the criminal laws.

Admission to the Union

After a bitter controversy over slavery, Congress admitted Texas to the United States in 1845, with Austin as its capital. The state kept its public lands and reserved the right to divide into no more than five states, a right which caused considerable agitation. Disputes with Mexico over the boundaries of Texas brought on the Mexican War. The outcome established the Rio Grande as the international boundary as far as El Paso (*see* Mexican War). Other disputes over boundaries arose between Texas and its neighboring states. In 1850 Congress purchased from Texas for 10 million dollars the claim of that state to some 100,000 square miles now included in the states of New Mexico, Oklahoma, Kansas, Colorado, and Wyoming.

When the Civil War came, slaveholding Texas seceded and joined the Confederacy despite Sam Houston's struggle to keep it in the Union. The last battle of the war was fought at Palmito Hill, near Brownsville, May 12-13, 1865, after Lee's surrender. (*See also* Civil War, American; Reconstruction Period; chronology in Texas Fact Summary.)

OIL FROM UNDER THE SEA

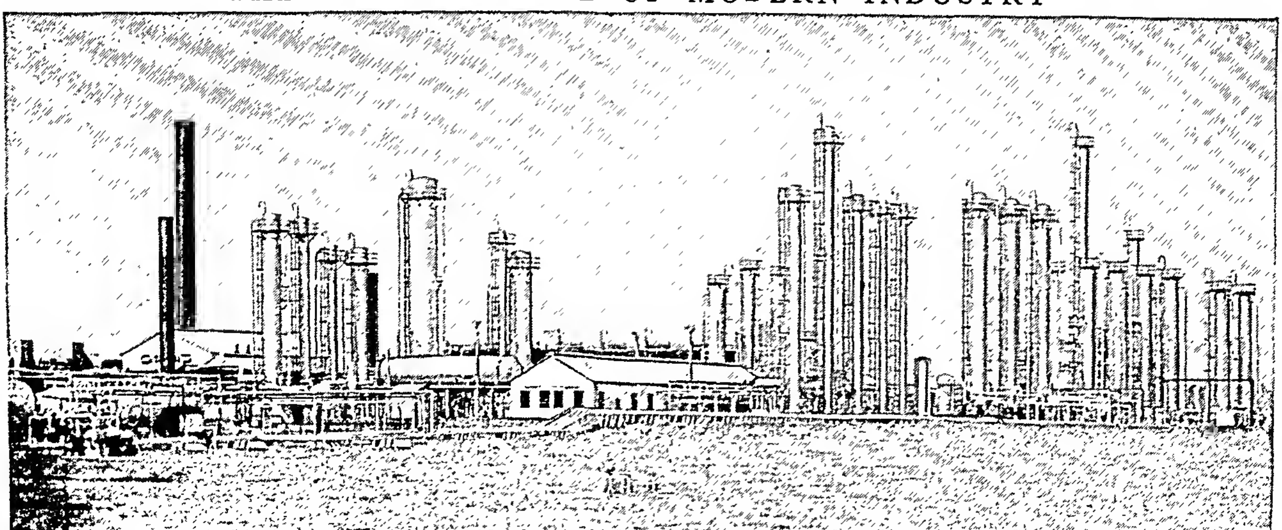


Texas and oil are almost synonymous. Not only do great deposits lie under inland Texas but also beneath the Gulf of Mexico.

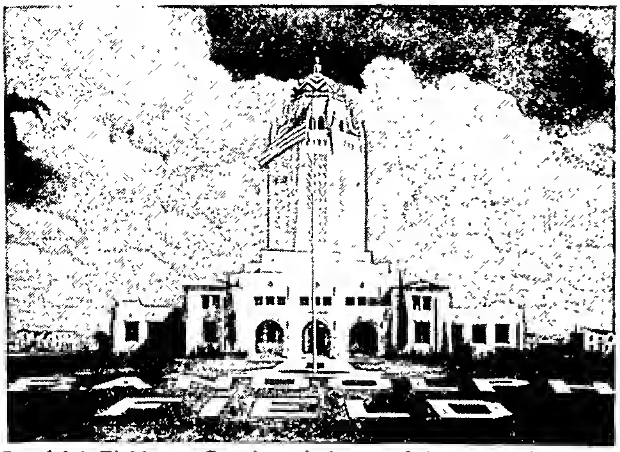
Government and Education

Texas has had four constitutions, the latest adopted in 1876. The governor appoints the secretary of state, with senate approval. Other executive officers are elected. The legislature meets biennially. Senators serve four years and representatives two years. One of the nation's first woman governors, Mrs. Miriam A. Ferguson, was elected in Texas in 1924.

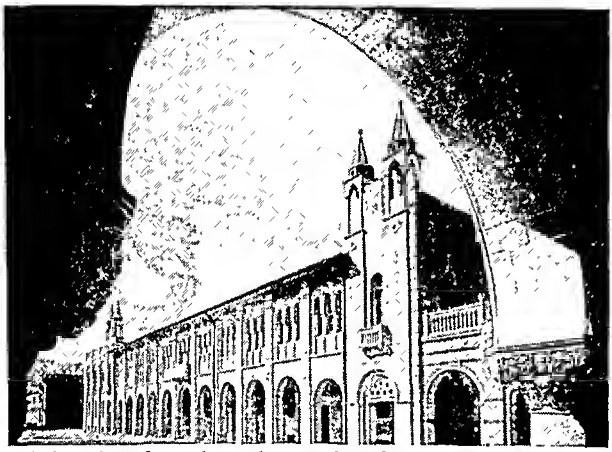
THE ARCHITECTURE OF MODERN INDUSTRY



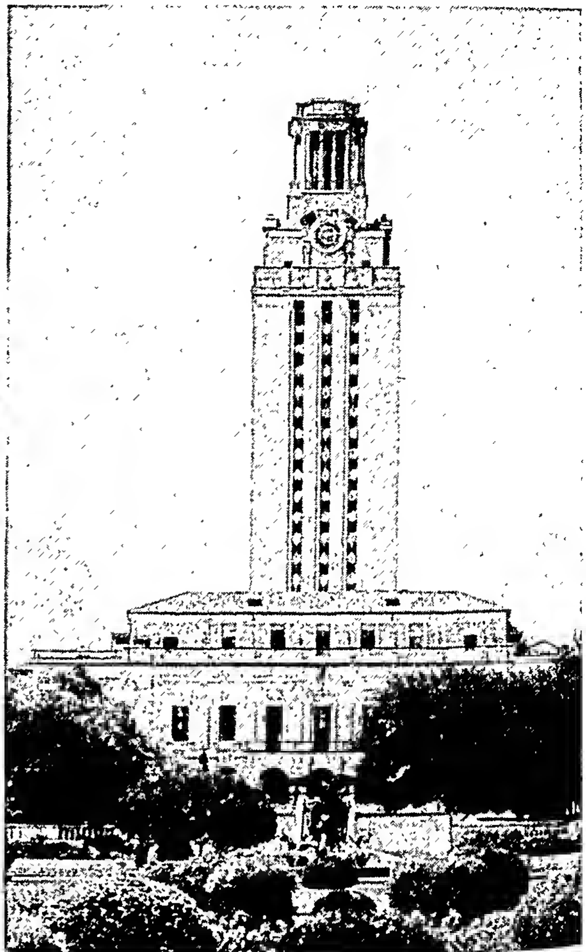
The towers of this natural-gas plant reproduce the style of American industrial architecture of today. In this mineral too Texas is first among the states. About one half of the known supply of natural gas in the country lies within the state.



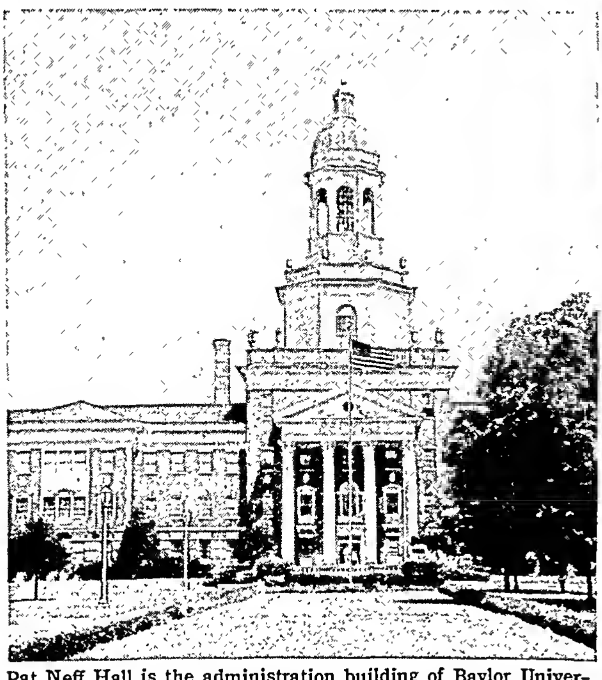
Randolph Field near San Antonio is one of the many Air Force bases in Texas whose climate and open surface favor aviation.



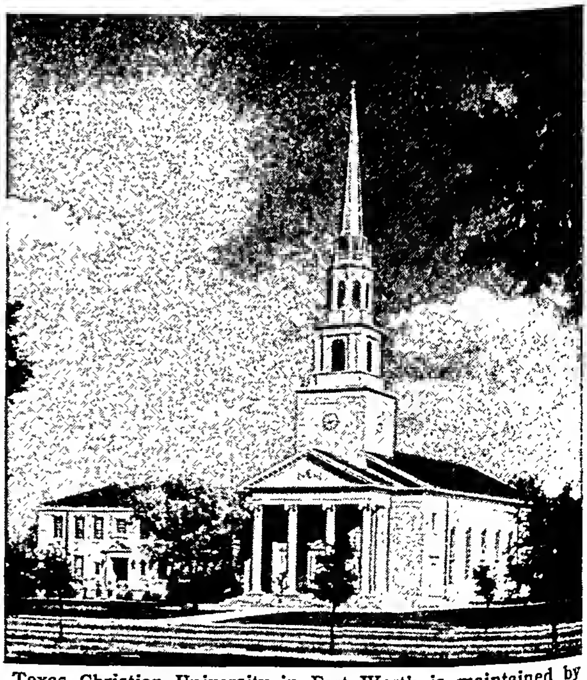
This is a view, from the cloisters, of the Physics Laboratories of Rice Institute in Houston. The school is high in academic rank.



This is the University of Texas at Austin, the keystone in the state's system of higher education. The tower soars 307 feet.



Pat Neff Hall is the administration building of Baylor University in Waco. It is a Baptist institution, chartered in 1845.



Texas Christian University in Fort Worth is maintained by the Disciples of Christ Church. Here is its Religion Center.

Education has always been of vital interest to Texas. One of the grievances against Mexico was that it failed to establish a system of free public schools. Since then Texas has built a very fine system. It set aside for educational purposes a portion of the public domain equal to the joint areas of Kentucky and Ohio. As this land is sold, the principal amount is invested and only the income is used. Through such funds, the state vastly improved its rural and urban schools.

The University of Texas is at Austin, with branches at Galveston and Dallas (medical), Houston (dental), and Texas Western College at El Paso. The Agricultural and Mechanical College at College Station has three branches. The largest of these, Prairie View Agricultural and Mechanical College, is for Negroes. Other leading colleges are Southern Methodist University, Dallas; Baylor University, Waco; Texas Technological College, Lubbock; Texas State College for Women, Denton; Rice Institute, Houston; and Texas Christian University, Fort Worth.

(*See also* United States, sections "The South" and "Great Plains.")

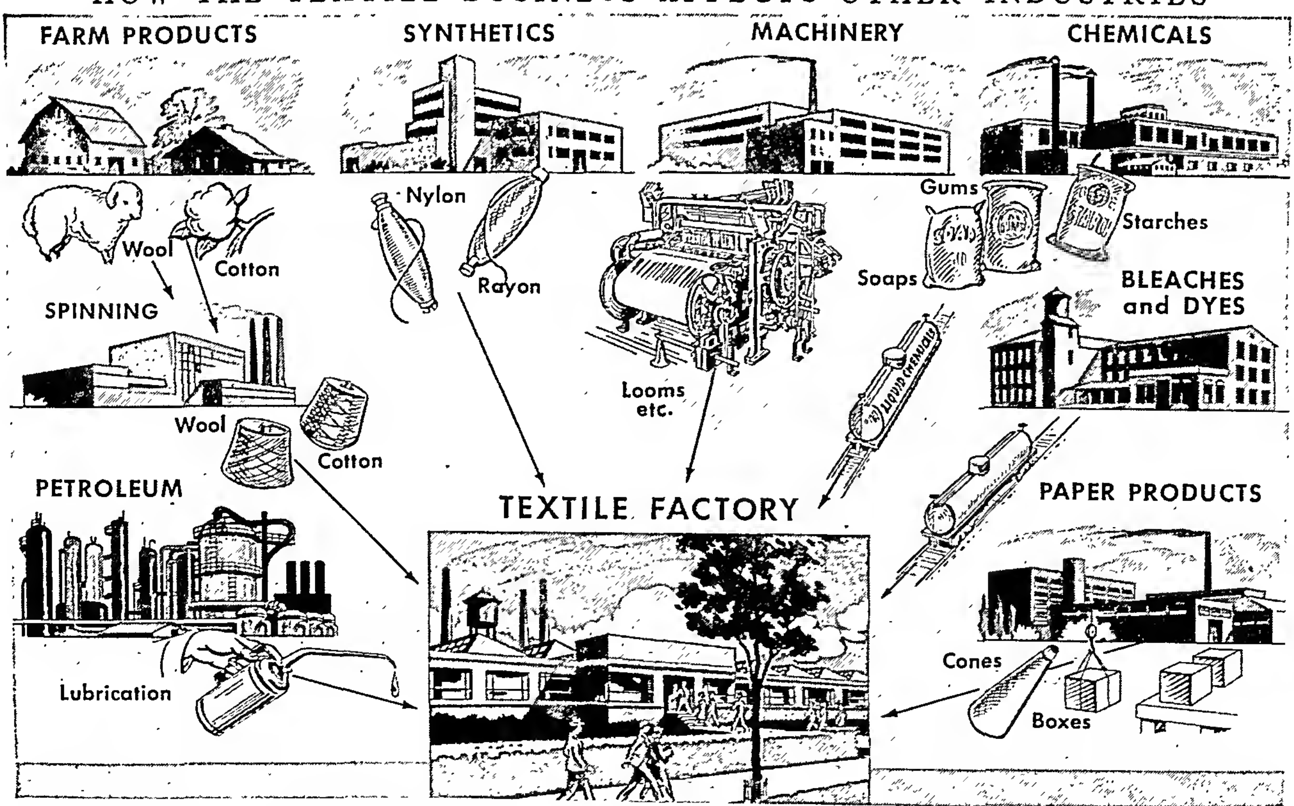
TEXTILES *and Their Part in* CIVILIZED LIVING

TEXTILES. A world without textiles is hard to imagine. For textiles include all woven fabrics, whether they are made of cotton, wool, rayon, nylon, or any other fiber. Woven fabrics provide the materials of most clothing—one of mankind's greatest needs. They are the source of many other things that make life comfortable. Textile products include sheets, blankets, hospital supplies, towels, table linen, curtains, rugs, and carpets. The list grows if the word textiles is not limited by its dictionary definition, "woven fabrics," but is considered in relation to modern machine production. Textile factories make knit goods, felt, lace, braids, and cords, as well as woven goods.

Clothmaking was the pioneer among modern industries. It was established as a hand industry long before there were power-driven machines. The wave of invention that introduced such machines in the 18th century brought spinning frames and power looms first of all (*see* Industrial Revolution). The mechanized textile industry provided cheaper fabrics than the world had ever known. The demand was tremendous. Clothmaking took the lead among manufacturing industries in each country as it became industrialized. It held the lead through the first quarter of the 20th century. Then in some countries it fell back from first place. This was not because textiles became less important but because improved machines and methods enabled other industries to grow.

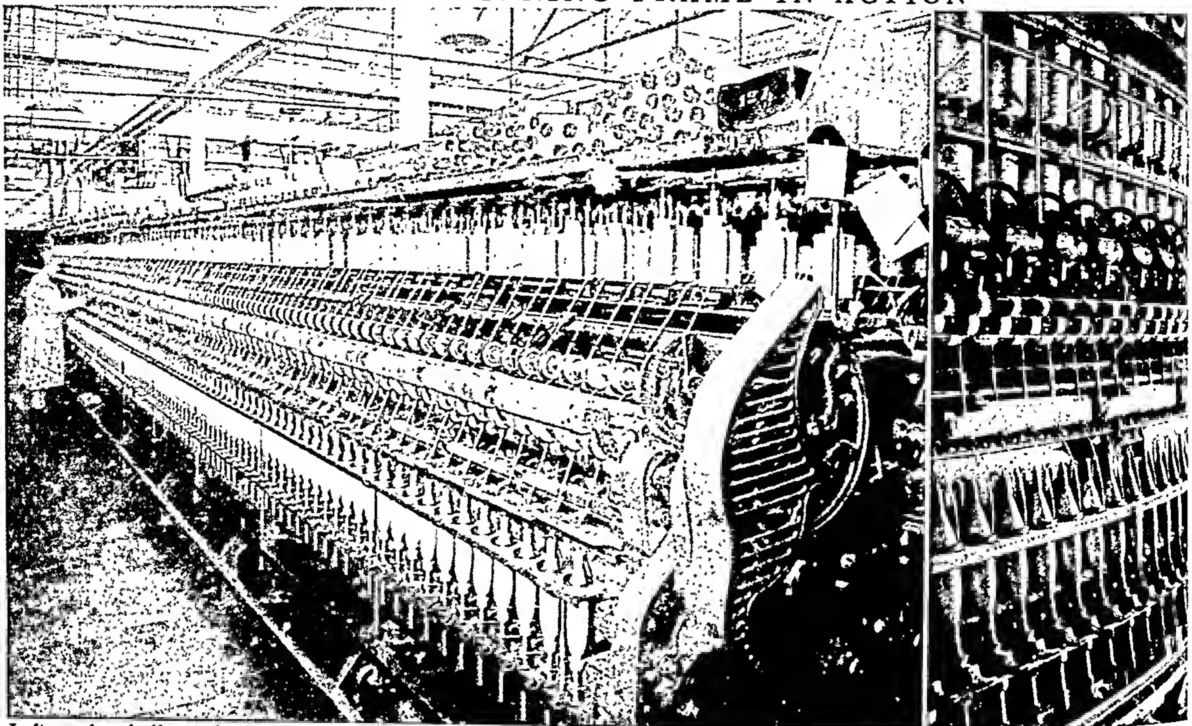
The rank of the textile industry does not tell the full story of its importance in a nation's economy. As the chart below shows, textile factories drain off the products of many other industries. In turn they furnish most of the raw materials for the huge

HOW THE TEXTILE BUSINESS AFFECTS OTHER INDUSTRIES



This chart shows some of the many and varied industries whose products make textile manufacturing possible. Textile mills are greatly dependent on these industries. In turn, much of the prosperity of the other industries comes from sales to the textile mills.

A RING SPINNING FRAME IN ACTION



Left, each spindle at the bottom of this machine is centered in a round track, or ring. Cones of roving (thick strands of fiber) are mounted above. Rollers running at different speeds draw out the roving into yarn. This goes through the rings to bobbins mounted on the spindles. The whirling spindles twist and wind the yarn. At the right is a close-up view of a similar machine.

clothing business (*see* Garment Industry). They provide the rubber industry with cord fabrics, upon which rubber tires are built. They supply paper factories with felts, and furniture factories with upholstery coverings and fillings. They make materials for electrical and heating insulation, belting for machines, gunny sacks, cords, and twines.

Textiles around the World

TODAY textile making is the biggest and most valuable manufacturing industry in France, Italy, India, Japan, and China. In the United Kingdom it ranks first in number of workers and second in value. It ranks second or third in most other highly industrialized countries. In the United States it is third in number of workers and sixth in value added to raw materials by manufacture.

Many countries which have comparatively little industry manufacture enough cloth to supply at least a part of their own needs. This is the case in Latin America. Brazil not only supplies its own requirements but makes silk yarn and cotton goods for export. Argentina and Peru make a high percentage of the textiles they use. Mexico, Venezuela, Colombia, and Uruguay have prosperous and growing factories.

Clothmaking persists as a home industry in out-of-the-way places throughout the world. It is not uncommon to see women in the highlands of Peru and Bolivia spinning in the ancient way, with a weighted spindle, as they walk and talk. The creaking of hand looms can be heard in peasant cottages in Greece and Italy, as it can in faraway China. Wherever a cloth-using people is isolated from machine production by distance or poverty, they continue to make cloth with the old tools, handing down their craft from mother to daughter through the generations.

Clothmaking by hand methods also survives in commercially successful enterprises. India weaves a substantial part of its yearly billions of yards of cotton cloth on hand looms. Country folk living on the Outer Hebrides Islands of Scotland weave the most famous tweeds in the world—Harris tweeds—in their thatched cottages. The Navajo Indians of Arizona and New Mexico continue to weave beautiful rugs, and they receive handsome prices for their work. In both Guatemala and Mexico hand-woven fabrics form an important item of tourist trade. A hand-loom factory in the mountains of Kentucky sells half a million dollars worth of textiles in good years.

Hand spinning does not always accompany hand weaving. Indians of the Americas usually spin as well as weave. But the weavers of Harris tweeds carry all but a small fraction of their wool to a local mill for spinning. Weavers in the hand-loom industry of India use machine-spun yarn, as do most hand weavers in the American South.

World Production of Textile Fibers

The raw materials of textiles are fibers that are spun into yarn for weaving, knitting, lacemaking, and braiding or are matted together to make felt (*see* Fabrics). Fibers can be classified as mainly industrial or mainly nonindustrial. The industrial fibers make chiefly gunny sacks and packaging materials, foundations for wool rugs and carpets, and simi-

lar products, as well as cords and twines. The nonindustrial fibers go chiefly into clothing and the household type of textiles.

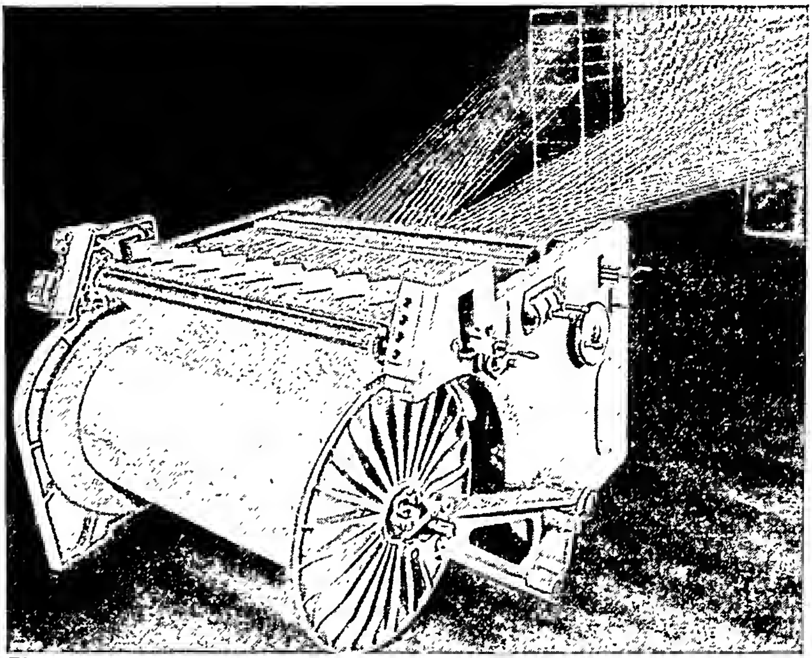
Jute is the principal industrial fiber. It represents about 13 per cent of the world's production of all textile fibers. Similar fibers are hemp, abaca, sisal, and henequen.

Of the nonindustrial fibers, cotton is by far the most important, representing more than 70 per cent of the total. Rayon, cotton's closest competitor, furnishes about 13 per cent, wool more than 10 per cent, and flax about 5 per cent. Silk and nylon together account for less than one per cent of the world's nonindustrial textiles. Of this small amount, nylon accounts for more than twice as many textile products as silk.

Although rayon and nylon are the only man-made fibers used in sufficient quantity to be included in the world picture, there are many others. Spun glass, or Fiberglas, appears in some fabrics. Orlon, fortisan, and celcos are plastic textile fibers similar to nylon. There are a number of other plastic fibers, including vinyon, saran, and velon. (*See also* Plastics).

Asia and the Americas contribute more than 70 per cent of the world's output of natural fibers and Europe only about 5 per cent. These figures do not include Soviet Russia's share, which is about 10 per cent. Europe, on the other hand, makes more than 40 per cent of all synthetic fibers. Leading European producers are Germany, the United Kingdom, France, and Italy. The United States manufactures about 45 per cent of the world's man-made fibers. (*See also* articles on the individual textile fibers.)

THESE YARNS WILL MAKE THE WARP

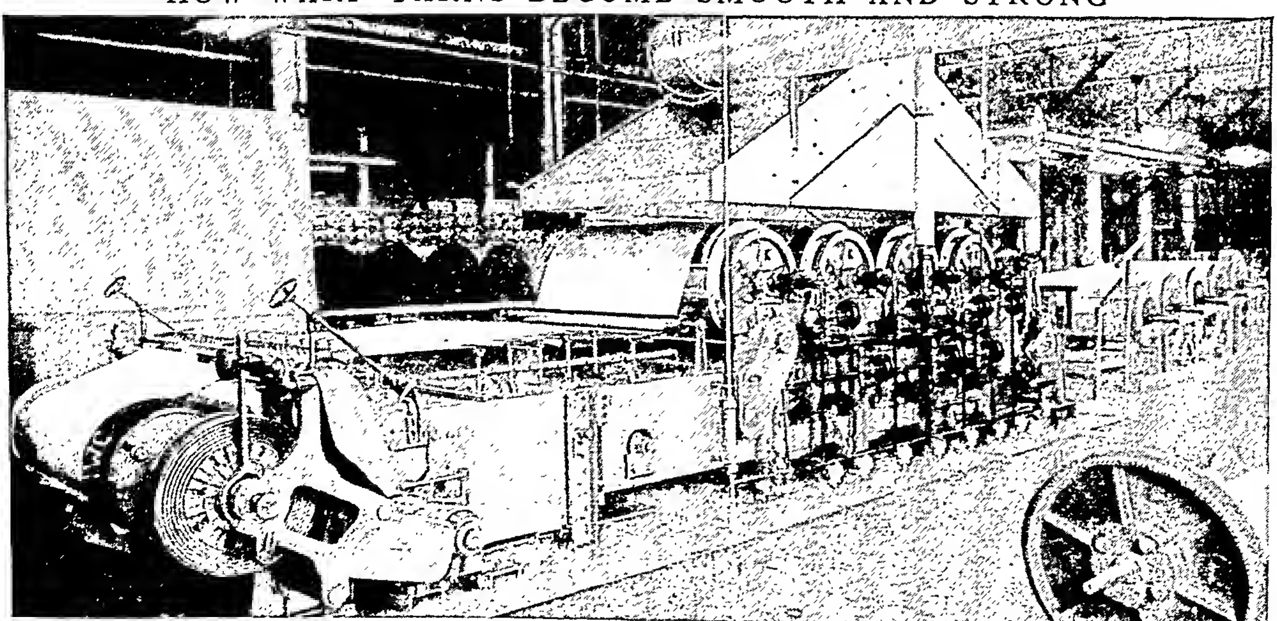


This giant spool is the modern version of the warp beam. It is being wound with yarn from hundreds of cones. Later, mounted at the back of the loom, it will unwind to supply the warp yarns. As these pass across the loom, a shuttle will carry filling yarn back and forth between them to make the weft.

Textiles and the Standard of Living

An account of the consumption of textiles tells a story of great contrasts in poverty and riches in the world. Figures issued by the United Nations show that five countries—the United States, Canada, Sweden, Belgium, and Switzerland—make and use almost half the world's cotton, wool, and rayon tex-

HOW WARP YARNS BECOME SMOOTH AND STRONG



Many yarns need a coat of starch to make them strong enough to serve as warp. Applying the starch, as shown above, is called "slashing" or "sizing." Yarns from several beams (extreme right) unwind together, blending to become one sheet. This goes through a bath of sizing and then between rollers under a hot-air drying unit. A warp beam (left) receives this prepared warp.

tiles. And these countries account for only about 11 per cent of the world's population.

The people of the United States have an average of more than 40 pounds apiece of cotton, wool, and rayon textiles in normal years. Canadians average about 27 pounds. The people of Sweden, Belgium, Switzerland, and the United Kingdom use approximately 25 pounds apiece, and those of Australia, France, the Netherlands, and Argentina from 18 to 21 pounds. Latin Americans average about 8 pounds and Russians about 5½ pounds. The millions in India, Japan, and China have only 3 to 5 pounds apiece.

These figures vary somewhat from year to year. But the ratios of one to another do not change radically. They indicate the contrasting standards of living around the world with regard to clothing, household conveniences made of fabrics, and other items, such as automobile tires, in which cotton, rayon, or wool textiles are important.

Textiles in World Trade

All countries use at home the bulk of the textiles they manufacture. Before the second World War 10 per cent of the world's output entered international trade. The percentage dropped to about 6 after the war. Yet world production is so tremendous that even these small percentages are sufficient to make textiles rank as a major item in world trade.

The leading exporters are the United Kingdom, the United States, Japan, China, India, Italy, Belgium, and France. A number of countries rank textiles as their most valuable export. The chief importers are Indonesia, Malaya, Soviet Russia, Canada, Australia, and British West Africa. (*See also* **Trade**, table, in FACT-INDEX.)

Building a Modern Industry

THE FIRST factory in the United States to convert raw material into a finished product by power-driven machinery was built in Waltham, Mass., in 1814. The raw material was cotton fiber, and the finished product a coarse unbleached cotton sheeting. The man whose mechanical genius and business foresight made the factory possible was Francis Cabot Lowell.

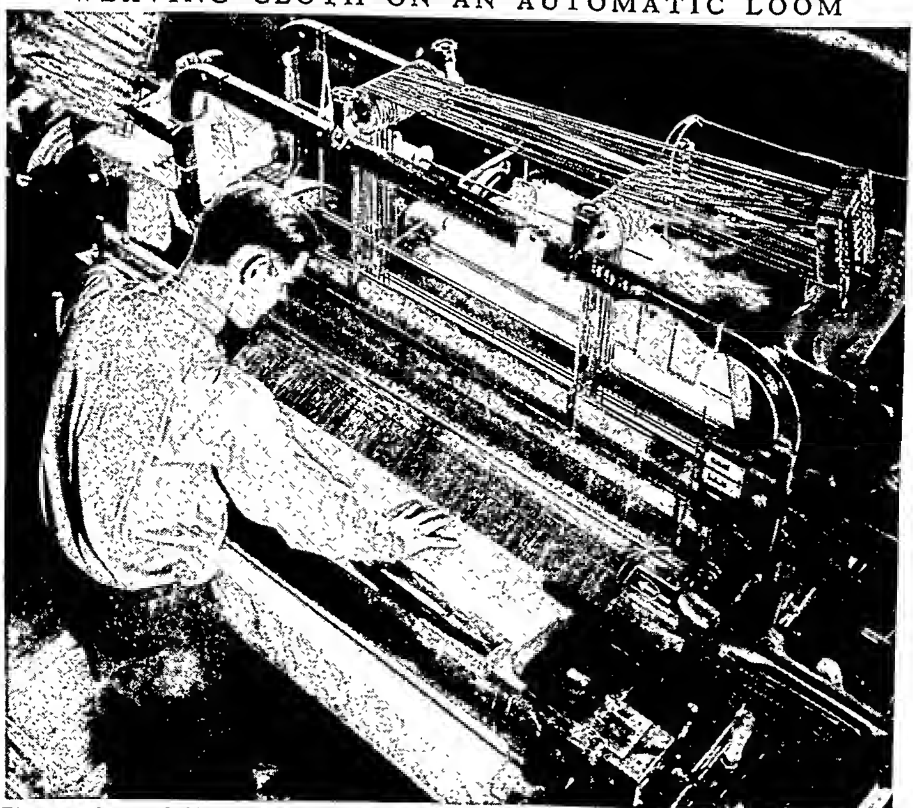
Cotton spinning was then a small, failing industry in New England. Samuel Slater, superintendent in one of Richard Arkwright's spinning mills, had come to America in 1789 despite British restrictions against emigration of skilled textile workers. He designed a water-driven spinning frame from memory and set up a mill in Pawtucket, R. I. (For a picture of Slater's mill, *see* Rhode Island). By 1810 New England had close to 90 spinning mills. But many of these failed after the War of 1812 when England again traded with the United States. American yarns could not compete with English yarns. (*See also* Arkwright; Industrial Revolution.)

Americans still made the finished product—cloth—on hand looms. Great Britain had a monopoly on power looms and refused to let the looms or plans for them leave the country.

Francis Lowell, a Boston merchant, visited England in 1810–12. The great cotton-manufacturing industry of Manchester fascinated him, and he studied it to good effect. When he returned to America he designed a power loom better than the English original, a carding machine, and a spinning frame. Then he secured capital from other Boston merchants and incorporated the Boston Manufacturing Company.

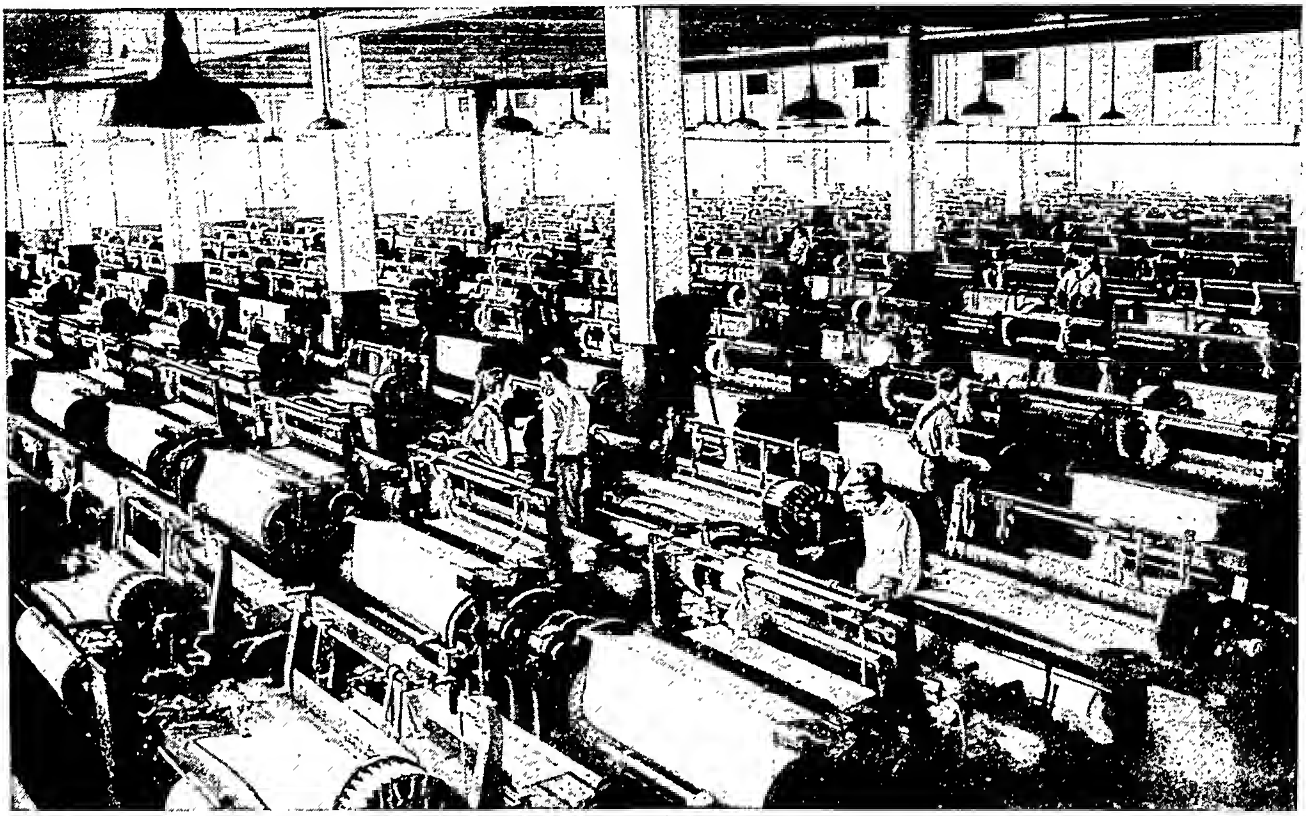
The company chose a site at Waltham, where the Charles River provided water power. Lowell supervised the building of a

WEAVING CLOTH ON AN AUTOMATIC LOOM



The warp beam of this loom is just visible at the back. A harness controlled by a pulley at the top of the loom has raised one set of warp yarns. This makes a shed, as indicated by the arrow, for the shuttle to pass through. A tray near the worker's wrist holds an extra shuttle. As the cloth is woven, it winds onto the roller, or cloth beam, mounted below at the front of the loom. On such looms the shuttle makes about 114 trips a minute through the warp.

MORE THAN A HUNDRED LOOMS IN ACTION



Here is the weaving room of a cotton factory in South Carolina. A few attendants can keep all these smoothly running automatic looms at work. When a bobbin is empty, a new one is mechanically inserted into the shuttle. If a yarn breaks the loom stops automatically. The looms of the United States turn out more than 10 billion square yards of cotton cloth a year.

machine shop and mill. He hired the daughters of New England farmers to run his new machines. To house the girls he built trim boardinghouses, each with a strip of lawn. This first mill town had wide streets, shade trees, attractive mill buildings, and a landscape unsmudged by coal smoke. And its cloth made an unexpectedly large profit.

In 1816 Lowell succeeded in getting Congress to pass a tariff protecting low-priced domestic cottons. He died in 1817, at 42, but he had already given the cotton-manufacturing industry a firm foundation.

An Infant Industry Becomes a Giant

Members of the Waltham company, with other Boston merchants, began constructing mills on the Merrimack River at East Chelmsford (later named Lowell) in 1822. In 1845 they built mills farther down the Merrimack at the site of Lawrence. (*See also* Lowell, Mass.; Lawrence, Mass.) They patterned both towns after Waltham. Some of the men who provided capital for the big mills became millionaires.

The mill girls were not so fortunate. As the industry grew, working conditions deteriorated. Mill towns became overcrowded, with a loss of light and air from homes and working quarters. Operators reduced wages in bad years and did not restore them in good years. The girls worked 12½ hours a day under increasing pressure to turn out more work. Native New Englanders left the mills gradually after many unsuccessful strikes for more pay and better conditions. Irish immigrants succeeded them. Newly arrived immigrants would accept conditions that American-born girls would not. French-Canadians, Portuguese, Poles, Italians, and Greeks followed the Irish immigrants into the mills.

America's first modern industry grew tremendously despite labor troubles. Textile factories sprang up beside most of New England's swiftly flowing rivers. In the later 1840's steam began to replace water as a source of power (*see* Water Power; Steam Engine). Owners built mills on the seaboard, convenient to the landing of coal shipments. Salem, Newburyport, New Bedford, and Fall River, Mass., and Portsmouth, N.H., developed prosperous cotton industries.

Cotton Manufacturing Moves South

Southerners built their first large cotton mills in the reconstruction period after the Civil War. The industry grew slowly until about 1910. Then it expanded rapidly. Southerners built new factories, and New England mills moved south. By 1925 the South was making more cotton goods than New England.

Advantages of the South to mill owners included cheaper and more abundant labor, nearness to cotton fields, lower taxes, fewer labor laws, and a large local market for cotton goods. Electric power was replacing both water and steam power in industry. Mountain rivers of the south supplied water power, which in turn generated cheap electric power.

Other Textile Industries Lag Behind Cotton

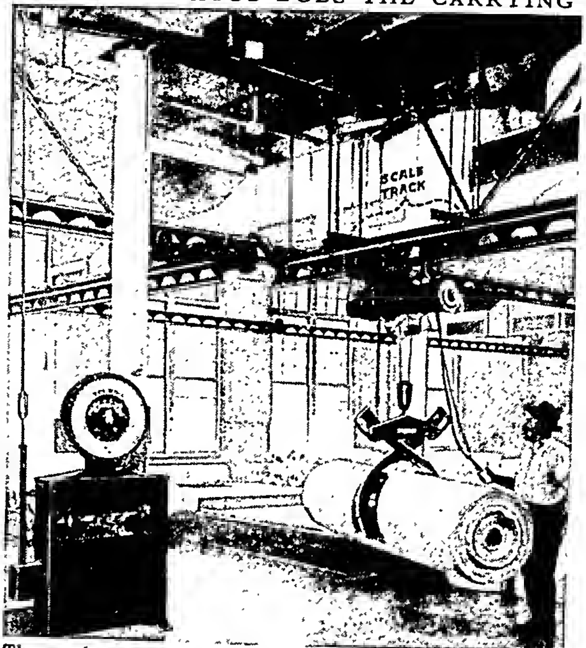
The first textile machines were suitable only for cotton. As they were adapted to the use of the other

fibers they usually were harder to manipulate, and skilled men were needed as operators.

By the time of the Civil War there were about 2,000 wool factories in the United States, but these were small and scattered. The event which finally put the wool industry on its feet was the introduction of worsted as opposed to woolen cloth (*see* Fabrics). The techniques for making worsted were like those for cotton. Factories, therefore, could hire unskilled women workers.

A mill in Lawrence, Mass., had begun to make worsted about 1854. During the Civil War many cotton factories made this material. The war had cut down their supply of raw cotton, and the army wanted worsted for uniforms. After the war the material found a ready market as men's suiting. This gave the wool factories a staple product as a foundation for development of the industry.

THIS APPARATUS DOES THE CARRYING



The workman presses a button and a giant pair of tongs picks up a heavy roll of cloth. A carrier on the overhead track takes the bolt to another part of the factory.

The Reign of Silk

There was some manufacturing of silk thread, fringe, and other trimmings before 1860. During the Civil War the Federal government imposed a duty on silk imports to raise money for the war effort. It continued the duty after the war as a protective tariff. The tariff provided an incentive for the manufacture of silk fabrics in the United States. By 1900 this country was second only to France in the manufacture of silks. In the meantime the American people were becoming richer. Soon many of them could afford to buy silk for everyday wear. By 1920 the United States led the world in making silk fabrics.

The reign of silk was short. Rayon, an unimportant fiber in the first quarter of the 20th century, almost eliminated silk from the weaving rooms in the 1930's. Its cheapness combined with a similarity to silk was the main factor. In 1940, 90 per cent of the raw silk used in the United States went into hosiery. The second World War cut off raw silk from Japan, and the hosiery mills substituted rayon. After the war they used nylon, which made stronger hosiery than silk. (*See also* Rayon; Nylon.)

Making Textiles in the United States Today

TEXTILE manufacturing in the United States today is a great sprawling industry with important production in more than 20 states. There are two principal manufacturing regions. New England and the Middle Atlantic states lead in making woolens and worsteds. The Southeast leads in cotton manufacture. The two regions produce about equal amounts of the synthetics. In annual listings, North Carolina, Pennsylvania, Massachusetts, and South Carolina usually lead as textile-producing states.

The industry has more than 8,000 factories. These vary in size from small mills with less than half a dozen employees to factories with more than 2,500 on the payroll. Some factories carry out only one of the clothmaking processes. They clean and comb fibers, spin, weave or knit, bleach and dye, print, or add a special finish. Other factories carry out all the processes.

Of the woven cloth made in the United States, about 60 per cent is cotton and 22 per cent is wool. The rest is mostly rayon. Production of other synthetics, especially nylon, is increasing. In terms of total production, the manufacture of silk fabrics is insignificant. Linen making never developed to any great extent as a machine industry in the United States.

Organization of the Industry

Many cotton factories spin yarn and weave it into unfinished cloth known as gray goods. Through brokers in New York City they sell this to *converters*. Converters send the gray goods to *finishers*, who bleach the goods, then dye or print it according to a design the converters have chosen. Finally, the converters sell the finished cloth as yard goods to wholesale dealers or else to garmentmakers.

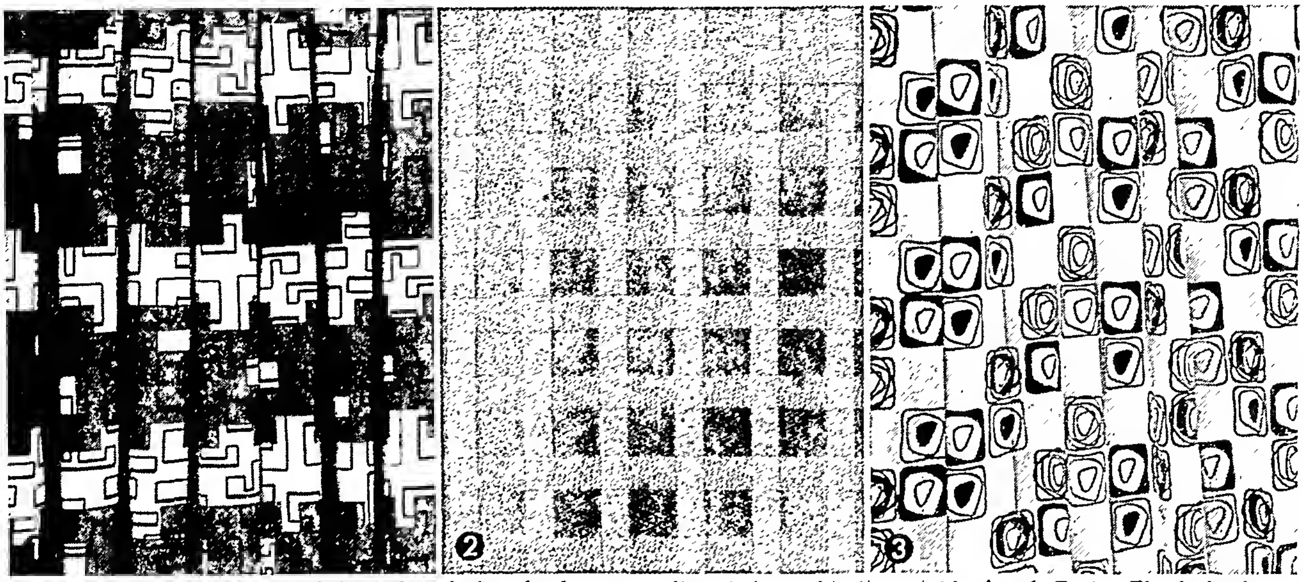
But some large cotton factories—or chains of factories under one ownership—carry out all the clothmaking processes themselves and go one step further. They manufacture staple articles, such as sheets, towels, pillow cases, and men's white shirts.

The wool industry is less complex. Wool yarn, if it is to be dyed, is usually dyed in the spinning mill. Wool fabrics as a rule are dyed and finished in the factory where they are made.

Production of synthetic yarns is actually a part of the chemical-manufacturing industry. One corporation may own plants for making the basic chemicals, other plants which convert these chemicals into yarns, and factories which make finished fabrics from the yarns. On the other hand, firms which are primarily manufacturers of chemicals may make the yarn and sell it to cloth manufacturers.

More than 90 per cent of the knitting factories make garments rather than fabrics. Their products include hosiery, underwear, gloves, sweaters, and

GOOD DESIGNS MEAN BEAUTY IN FABRICS



These pictures show three trends in modern designs for drapery textiles. 1. A nonobjective print by Angelo Testa. The design is not derived from any natural object. 2. A fabric by Dorothy Liebes. Its beauty is due to the use of yarns of contrasting textures and to the suppleness of the weave. 3. An abstract print with a floral motif, by Ben Rose. He calls it "a rose is a rose."

dresses. Manufacturing rugs and carpets is a separate branch of the textile industry. (*See also* Knitting Machines; Rugs and Carpets.)

Almost a million and a quarter people work in the great textile industry. More than 390,000 belong to the Textile Workers Union (C. I. O.). Labor laws, unionization, better methods of production, and modern lighting and air conditioning have gradually improved working conditions in the factories.

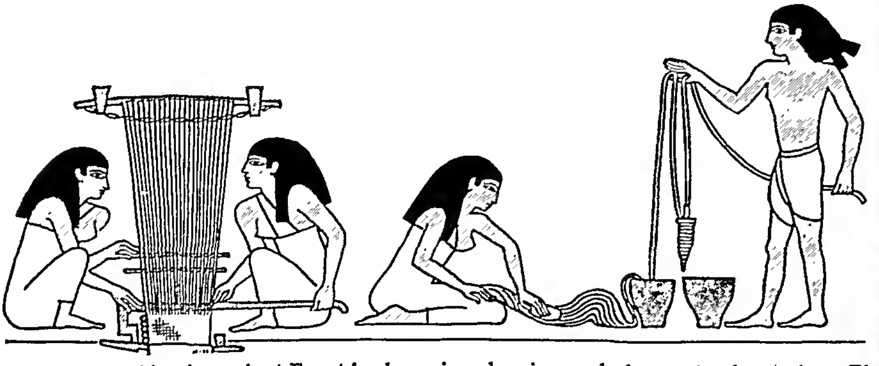
Textile Machinery Today

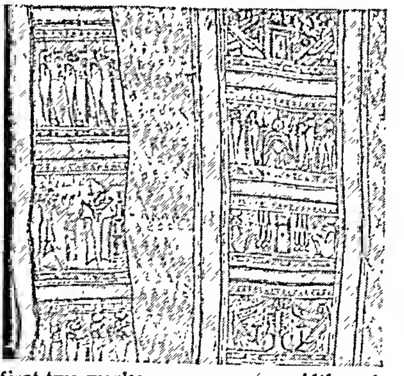
Modern textile machines are run by individual electric motors. They operate smoothly and so rapidly the eye cannot follow all the movements of yarn and machine parts. Among the most important of their many automatic devices are those which halt a loom or a whirling spindle if a yarn breaks.

A revolutionary weaving machine introduced in 1949 replaced the usual one-pound shuttle with a one-ounce metal yarn carrier. In 1950 a device to wind bobbins on the loom itself appeared.

The northeastern states make more than 80 per cent of the country's textile machinery. The small industrial area adjoining Boston and Worcester, Mass., and Providence, R. I., alone makes about half.

Textiles through the Ages



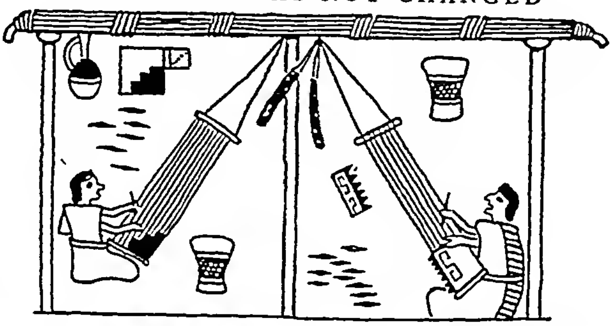


Left, clothmaking in ancient Egypt is shown in a drawing made from a tomb painting. The first two workers are weaving. Although the painting made the loom look vertical, it was actually horizontal. The third worker is cleaning and straightening flax fibers. The fourth worker is spinning. At the right is a fragment of an Egyptian mummy cloth painted with scenes of the future life.

AMONG the oldest man-made articles in the world are fragments of textiles. Some are coarse and plain. Others are beautiful. All are interesting because of the stories they tell about the everyday life of ancient people. Archeologists found these pieces of cloth and garments in tombs, in buried cities, and in other ruins. Sometimes they found spinning and weaving tools as well. Museums treasure and display these relics today.

Perhaps the best-known ancient textiles are linens found in the tombs of Egypt. The drawings above, from a tomb painting thousands of years old, show how these were made. (For a detailed account of primitive hand methods, *see* Spinning and Weaving.)

THE LOOM HAS NOT CHANGED



The top picture is from an ancient vase found in the Andean region of South America. The lower picture shows a girl of today in Guatemala. The looms are identical. Each is secured at the lower end by a strap across the weaver's back.

Most Egyptian clothmakers were bound to the service of the pharaohs or to temple workshops. Some were slaves on the estates of wealthy noblemen. They produced linen of the finest texture. It made cool white garments for pharaohs, priests, and nobles (*see* Dress). It provided wrappings for the dead which sometimes measured 60 inches wide by 60 yards long. The workers themselves used coarser grades for their simple clothing.

The Egyptians' most ancient way of decorating fabrics was to paint them. Favorite motifs in their designs were the lotus blossom, a zigzag line representing waves, and the sacred beetle. Some of the mummy cloths were painted all over with scenes of religious significance.

Textiles of the West

People living long ago on the dry coastal strip of Peru created some of the world's most beautiful textiles. Archeologists have found an amazing quantity of these in "mummy bundles" tucked away in tombs. These ancient people of the Andean region, like those of Egypt, believed the dead needed articles from this life to use in their future life. Some fragments of the cloth are 3,000 years old, but the finest examples belong to the period between about A.D. 300 and 1000.

The people who wove these textiles must have loved their craft. They spun fine, smooth yarn of cotton or the wool of alpacas, llamas, and vicuñas. They used most weaves known today and some too complicated for modern looms. They were expert dyers, with almost 200 hues at their command. With their many-colored yarns they worked out gay, elaborate designs. They had ingenious ways of weaving cloth into the shapes of garments and other articles, for they did not cut and sew.

Europe's Oldest Cloth

Weaving was probably part of the housewife's daily work in the homes of the European Lake Dwellers. These Stone Age people built their villages, presumably for safety, on wooden platforms over lakes and swamps (*see* Man). In the beds of the lakes modern searchers recovered spindle whorls, pieces of looms and of linen and woolen garments.

It is believed that the men of the family raised flax and sheep on farms near the lake villages. Girls and women probably cleaned and prepared the fibers and spun the yarn. They dyed the yarn blue or brown—perhaps also red or yellow—with coloring matter from plants and bark they gathered in the nearby forest. Then one of the most skillful members of the family stood before a warp-weighted loom to weave the colored yarn into plain, strong cloth.

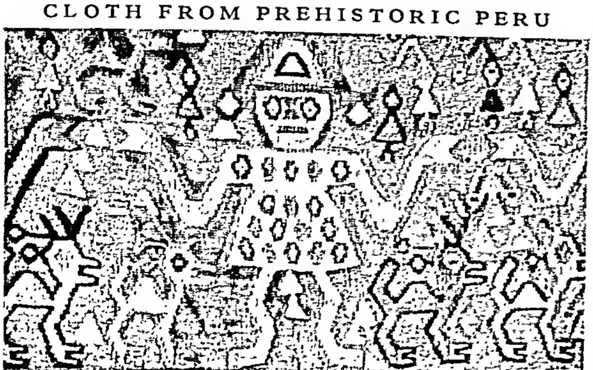
Cloth in Ancient Greece and Rome

The textiles of earliest Greece exist only in legend. The tale of Penelope and her loom is known the world over (*see* Odysseus). Homer refers often to "fair purple blankets" and "thick mantles." He describes Helen as working with a golden distaff, a silver wool basket on wheels, and wool of violet-blue.

Many written accounts tell how people made cloth in Greece's golden age—the 4th and 5th centuries B.C. Sculptures, bas-reliefs, and vase paintings show that the cloth was fashioned into loose, flowing garments (*see* Greece; Greek and Roman Art).

Women of this period, like the women of Homer's Greece, made cloth at home, often with the help of household slaves. But they could also buy cloth in shops. These had sprung up in the chief cities of Greece. Some were small craft shops run by freed slaves, free Greek artisans, or skilled workers from foreign lands. They usually specialized in one process—cleaning and carding, spinning, dyeing, or weaving.

CLOTH FROM PREHISTORIC PERU



This fabric is more than 1,000 years old. The ancient weaver worked out its complicated design in many colors in a tapestry weave. Such tapestry cloth from the Andean region is finer and firmer than the medieval tapestries of Europe.

Many of the workers belonged to craft gilds. There were also large workshops, where slaves of rich men made cloth to be sold.

Greek cloth was linen or wool. It was not fine, because the people were still using primitive warp-weighted looms. But it was dyed a bright color or bleached white. It might be trimmed with a painted or embroidered border or small all-over pattern. Simple geometrical designs were favorites.

The Greeks imported purple cloth from Tyre, embroideries from Sidon, and fine linen from Egypt. After Alexander the Great conquered the Persian Empire, trade with the Far East by way of Susa developed. Sheer muslins from India and figured silks from China found their way into the homes of wealthy Greeks.

SELLING CLOTH DURING THE MIDDLE AGES

Champagne, France, had great annual fairs during the Middle Ages. The cloth fair occupied the first 12 days. Townspeople and traders came to buy, and weavers came to sell. The picture above shows a cloth fair at Champagne in the 13th century.

The Romans, who conquered the Greeks in the 2d century B.C. followed the clothmaking practises of the Greeks. They did, however, abandon the old warp-weighted loom in favor of the more efficient two-barred loom. They established textile factories in the provinces, particularly in Gaul, where they had found a people already skillful at weaving. Trade grew, with roads policed by soldiers of the Roman legions. By the 2d century A.D. there was a protected trade route all the way to China. Merchants brought many luxuries back along the roads that led to Rome. Among the finest fabrics were rich brocades, cloth of gold, and jeweled embroideries.

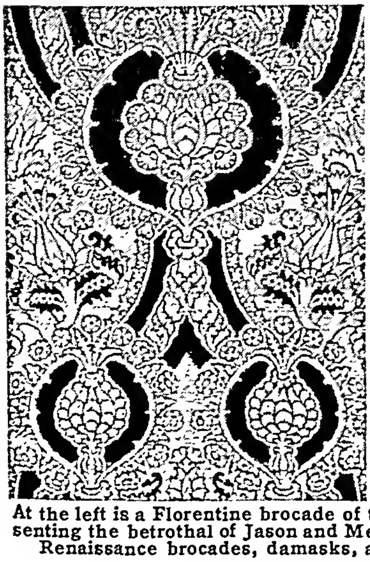
Textiles in the Middle Ages

The barbarian invasions which finally broke up the western Roman Empire did not destroy the textile crafts. People continued to make cloth in their homes. More important, clothmaking grew as an industry in the towns of Europe throughout the Middle Ages.

The way of working was similar in towns everywhere. Carders bought raw wool or flax, cleaned and carded it. Then they sold it to spinners. Spinners sold their yarn to dyers or weavers. Weavers might sell their cloth to dyers or fullers. These men finished the cloth and sold it, usually at a cloth fair (*see* Fairs and Expositions). Or weavers might take the cloth to a public fulling mill to be fulled, napped, and tentered. Then they sold the cloth themselves. (For an explanation of the finishing processes mentioned, *see* Fabrics.)

The craftsmen worked individually at home but were organized into craft guilds (*see* Guilds). Their homes were usually a combination of cottage and workshop.

RENAISSANCE FABRICS AND FASHIONS IN NORTHERN ITALY



At the left is a Florentine brocade of the 15th century. The center picture is a drawing from a 15th-century Italian painting representing the betrothal of Jason and Medea. It shows the style of dress in Venice and Verona at the time. Costumes like these, made of Renaissance brocades, damasks, and velvets. hung in heavy, lustrous folds. At the right is a 15th-century velvet from Genoa.

EIGHTEENTH-CENTURY PRINTED COTTONS FROM ENGLAND AND FRANCE

The English chintz at the left above is a gay adaptation of Chinese decoration. At the right is a print made by the factory of Christophe Oberkampf at Jouy, France, in 1785. It tells the fable of a miller and his son who took so much advice about getting their donkey to market that they ended by carrying him. Cloth from the Oberkampf factory is known as toile de Jouy.

European cloth of the early Middle Ages was wool and linen—the fabrics of the lake dwellers and of ancient Greece and Rome. Silk and cotton had had a legendary origin, the one in China and the other in India. Alexander the Great established cotton growing in Greece. Knowledge of silk culture came to Constantinople in the reign of Justinian (*see* Silk). Cultivation of both cotton and silk developed in the Byzantine Empire. Conquering Moors carried it to Spain in the 8th century and to Sicily in the 9th.

The silk industry spread through Italy in the 12th and 13th centuries. This spread was partly a natural one, from Spain and Sicily, but it gathered momentum because of raids into the East. Roger II of Sicily attacked Greek cities in 1146 and brought captive silk weavers back to Palermo. Venetians acquired silk-producing districts in Greece during the Fourth Crusade (*see* Crusades). Italian cities became famous for their silks. Lucca made gold and silver cloth, brocades, damasks, satins, and velvets. Florence, Genoa, Modena, and Bologna had thriving industries.

Raw cotton appeared in Italy about the middle of the 12th century. Traders from Genoa and Venice brought it from Antioch and Sicily and from the Orient by way of Alexandria. Weavers used it to make fustian, a coarse material combining cotton and linen.

Italy made more and better cloth than any other region during the Middle Ages. Italian workshops were known for excellent woolens and linens as well as for silks. In the later Middle Ages, Spain and Flanders produced fine woolens. Good linens came from Spain and France. Germany made only coarse cloth but, in the 12th century, developed the art of textile printing. England's rôle during the Middle Ages was to supply Europe with most of its raw wool.

The Industry Continues to Grow

Clothmaking became the most important means of earning a living in France during the 13th century and in England during the 15th. Skills increased as knowledge of crafts was handed down through the generations. Looms acquired harnesses for raising different sets of warp threads and pedals to operate the harnesses. Spinning wheels appeared. (*See also* Spinning and Weaving.)

Louis XI brought silkworms, looms for silk weaving, and expert weavers from Italy to France in 1480. The silk industry grew slowly in France, but Lyons and Tours became famous for silks and velvets in the reign of Louis XIV. Thousands of French weavers left France in 1685, when Louis outlawed Protestantism by revoking the Edict of Nantes. They fled to England, Switzerland, and Germany, and helped to develop silk manufacturing in those countries.

Factories and Capitalists

Although making textiles was essentially a home industry, there were always a few factories. The methods, of course, were the same hand methods followed in the craftsmen's homes. But the owner or patron of the factory gathered a number of workmen together to make cloth for his own use or to be sold.

Antioch and Tyre had large silk factories during the Middle Ages. Similar establishments in Constantinople made embroidered woolens, fine linens, and silks for the Byzantine emperors. Silk weaving in

Italy developed in factories. Louis XIV established tapestry factories in France (*see* Tapestry).

A new type of organization appeared late in the Middle Ages. The supply of cloth often exceeded the local demand. And transportation had improved. Merchants became the link between weavers and distant markets. They bought the craftsmen's wares at "market towns," where weavers gathered from near-by towns and villages on regular market days, or at annual fairs like that at Champagne, France.

In time some of the traders became "merchant capitalists." Instead of buying finished cloth from independent craftsmen, they bought raw fibers and paid the craftsmen to convert them into cloth. This practise developed into the "putting out system," which in turn gave way to the modern factory system.

A Fine Art Helps to Start a Revolution

British merchants began direct trade with India at the beginning of the 17th century. Among the articles they brought home were printed cottons. These India prints were real works of art, dyed by a complex process which involved hand painting and several dye baths for each piece. They had lovely floral patterns in bright colors, and they could stand any amount of washing. The English called them "chints," from the Hindu word *chint*, meaning color.

Indian chintzes became all the rage. People used them for bed hangings, dresses, and furniture covers. Finally a law banned their importation because they cut into the woolen industry. Then English clothmakers produced imitations, using wood blocks for the printing

But English spinners found it difficult to spin cotton on spinning wheels designed for wool or flax. On their hand looms, the weavers could not make cloth as wide as the Indian chintzes. Block printing seemed slow work to men who knew they could sell all the printed cloth they could make. English artisans, therefore, concentrated on devising faster ways to make cotton cloth and to print it. From their efforts came the inventions that touched off the Industrial Revolution (*see* Industrial Revolution).

THACKERAY, *Great* REALIST *and Satirical* HUMORIST

THACKERAY, WILLIAM MAKEPEACE (1811–1863). In the opinion of more than one critic, this English novelist and satirical humorist is the most thoroughly representative man of letters of his age. His collected works fill 26 volumes and are in many modes—prose, verse, romance, parody, burlesque, essay, biography, criticism—yet there is not one, as Frederic Harrison says, which can be put aside as worthless and an utter failure. He was an English gentleman, who wrote the language of an English gentleman of his day. And, as a man who was once his enemy said, his knowledge of the human heart was greater than that of any other except perhaps Balzac and Shakespeare.

Thackeray's Life in Brief

Thackeray was born July 18, 1811, at Calcutta, India, the only child of Richmond and Anne Becher Thackeray. His father, who was in the employ of the East India Company, died four years later and at six years of age the boy was sent home to England for his education. After six years at the famous Charterhouse, he entered Trinity College, Cambridge, which he left after a year and a half without a degree. During 1830 and 1831 he spent a year abroad. Returning to London he began to study law but soon turned to art and went to Paris (1834) to pursue his studies. In 1836 he established with his step-father, Major Carmichael Smyth, a short-lived newspaper for which he became Paris correspondent. At Paris, Aug. 20, 1836, he was married to Isabella Shawe. Their children were Anne Isabella (1838), later Mrs. Ritchie; a daughter who died; and (1840) Harriet Marion, who married Leslie Stephen. Soon after his marriage Thackeray decided upon the profession of letters, which he followed in London the rest of his life. In 1860 he became the first editor of the *Cornhill Magazine*, in which 'Dennis Duval' was appearing at his death. He died Dec. 24, 1863.

The Calamity that Started Him on His Career

The turning-point in Thackeray's life was the calamity which befell him when he was not yet 29 years of age. The birth (1840) of his daughter, Harriet Marion, affected his wife's mind, and, despite his untiring efforts for months, she did not wholly recover. At length, forced sadly to recognize that she would be better off without him, Thackeray placed her in a friendly home. Thenceforth, his chief object was to maintain her in comfort, to protect his two little girls, and to leave them a competence. Already he had adopted letters for his profession and had written a few brilliant but fugitive tales and sketches for magazines.

Now in his unhappiness he produced 'The Great Hoggarty Diamond', earning a measure of fame which had been denied to his periodical writing. This success inspired a reprint, under the title of 'Comic Tales and Sketches', of previously published stories, including 'The Yellowplush Papers'. Soon he was invited to write for *Punch*. With Shirley Brooks and John Leech, he raised the magazine to first rank and helped maintain it there for more than ten years by his illustrations as well as by his articles.

Though in the course of his life he contributed to 27 periodicals, to *Punch* he gave his best criticism, satire, parody, versifying, caricature, political comment, drawing—all that constituted him the star contributor. And though this ephemeral expression, peculiarly Thackerayan in sweeping variety, was to a degree satisfying, the author felt he was not advancing as, say, Charles Dickens was advancing, with 'Pickwick' and other novels trumpeting success. To be sure, through this multitude of pot-boiling features, he was developing his genius and gradually approaching his destined climax, but at a cost—at a terrific cost, for he died an incredibly exhausted old man at 52, his six feet four shrunken, his magnificent brain weary from incessant toil.

Start of His Literary Career

At the beginning of his career he had to overcome a constitutional laziness to exert fully his powers in one direction. He prodded himself toward concentration. A visit to Ireland (1842), he celebrated with the 'Irish Sketch Book'; a tour to the Mediterranean (1844), with 'Notes of a Journey from Cornhill to

Grand Cairo'. A novel completed on the latter tour did more to advance him than did the 'Notes'. This novel was 'Barry Lyndon: A Romance of the Last Century', the story of a criminal that only Fielding or Thackeray could have written. In continuity and cumulative wealth of detail it is superior to either of his two masterpieces, 'Vanity Fair' and 'Henry Esmond', and as a whole it is only slightly below them. With Anthony Trollope, one must agree that in no display of mental force did he rise above 'Barry Lyndon'. And in 'Barry Lyndon' he had reached maturity of style.

Now, at the age of 35, Thackeray was still unknown beyond his friends and the small literary circle that had lifted the mask of his various pen names. For, following the fashion of the times, he had published all his earlier pieces under such fanciful names as "Yellowplush," "Fitz-Boodle," "Jeames," and "Mr. Snob." Most suggestive of these pen names was his favorite "Michael Angelo Titmarsh," for Thackeray's nose had been broken by a schoolmate just as Michelangelo's had been broken more than three centuries before.

WILLIAM MAKEPEACE THACKERAY

Thackeray was a giant in physique as he was in spirit. He stood six feet four, and had a head so massive that in boyhood he took a man-sized hat. But he had "a little dab of a nose," and he was near-sighted.

Moreover, his works were not popular: his attacks upon mankind's faults and foibles did not inspire popular liking; nor did intelligence, his predominant characteristic, draw a wide audience. Yet he was about to conquer the public on his own grounds.

'Vanity Fair' Brings Fame

In January 1847 appeared the yellow cover of the first number of 'Vanity Fair', published as a serial in monthly instalments. Month by month its readers increased and when the final twentieth came out, Becky Sharp was on everybody's tongue. Through 'Vanity Fair', Thackeray began to share honors with Dickens. Though never attracting so many readers as Dickens, he was lionized, patronized, entertained. He loved it all, from drawing-room to dining-room. Society became his ally in writing, since from this society he now drew some of his types. It also became his personal ally, making him gentler, more kindly humorous.

Except for *Punch*, he withdrew from periodicals and went on with the novels. The series, so well begun with 'Barry Lyndon' and 'Vanity Fair', continued through 'Pendennis', publication of which (1848) was interrupted by illness; 'Henry Esmond', "a book," says Lewis Melville, "to be ranked among the greatest works of historical fiction of any age or country"; 'The Newcomes' and 'The Virginians'. These six are topmost, but others are still read by lovers of Thackeray's gifts and expression.

Before 'The Virginians' appeared, the author welcomed an invitation to lecture; he wished to earn money for his daughters, and did earn it, leaving them an income better than the one he had inherited and lost early in his career. After a successful series of lectures on the English humorists, he followed his triumph up two years later, less successfully in England, by a series on the four Georges. The lecturer visited America six months for each series (1852–1853 and 1855–1856), where he created a fine impression and endeared himself as Dickens had not done.

His Love for the Eighteenth Century

Both sets of lectures dealt with the 18th century, which Thackeray especially loved. This love is one source, perhaps the chief source, of his literary achievement. It manifests itself most notably in 'Henry Esmond', which inimitably conveys the feel and atmosphere of Queen Anne's reign and later. In truth, from the point of time, Thackeray looked not forward but backward. Admiration for Fielding, greatest of 18th-century novelists, partly inspired 'Catherine' and 'Barry Lyndon'. It particularly inspired 'Pendennis', which attempts to describe a natural man, weak, selfish, untrustworthy, much as 'Tom Jones' describes a factual, non-heroic man of Fielding's day.

Thackeray as a Realist

Inclination toward the real, encouraged by the example of Fielding, prompted Thackeray's reaction against novels exploiting conventional heroes and heroines, or heroic figures, or sentimental men and women. In 'Catherine', a story of jailbirds, he protested against rose-water novelists, who wrote of impossible heroes; here was his earliest definite expression of belief that lives of rogues should be described, as well as other lives. Because the heroic seemed untrue, he could not paint heroic characters; reaction against Scott produced 'Rebecca and Rowena', the finest burlesque in the language, a burlesque having the merit that it can be read without in the least detracting from pleasure in 'Ivanhoe', of which it purports to be a continuation. Thackeray was not for the sentimental, not for the heroic, but for the real. To his disgust for the maudlin, the foppish, the vulgar, is attributable much of his satire.

His realism lacked sordidness and was, in balance and harmony, singularly effective. In 'Catherine', antipathy for the vicious joins sympathy for the murderess. If, in 'Pendennis', Blanche is a young woman of shams, Laura is a young woman of honest nature, whose love for Arthur never wavers. So fascinated the author became in Barry's fortunes as to create a half-admiring reader; and more than one non-admiring reader erred in suspecting that Barry's specious logic

was meant to argue not against him but for him. So subtly, so surely, Thackeray created Beatrix, that he was unable to show, or did not show, precisely what she was until her final step with the Pretender. He likes, and the reader likes, Pendennis. In all these instances Thackeray's art created as life itself creates.

Because he was a realist he relied upon real men and women. Colonel Newcome, for instance, has his origin in Thackeray's stepfather, Major Carmichael Smyth; Dobbin, in his Trinity friend, John Allen; yet the created figures are as different from the originals as Pendennis is different from Thackeray himself. In the historical characters, of course, such as Dick Steele and Lord Mohun, the author was at pains to create true portraits with all the virtuosity of which he was capable. As realist he also used scenes and incidents out of observation and experience. Exeter is Chatteris; in the earlier books, Charterhouse is Slaughterhouse, in the later ones, Grey Friars. Rawdon Crawley, Pendennis, Colonel Newcome, and Philip—conveniently for Thackeray—all spent their boyhood at his old school. So Pendennis goes to Cambridge, perfectly remembered and described by Thackeray after 20 years.

Satire Balanced by Sentiment

Realism and satire walk hand in hand throughout the works of Thackeray. While at Trinity College, he wrote for the *Snob;* even at the Charterhouse he displayed in his drawings, verses, and parodies a sense of the ridiculous not infrequently associated with contempt. Had he finally chosen drawing for his preferred medium, he would have belonged to the Hogarth school. At a suspicion of snobbism or vulgarity in life or of false sentiment in literature, he was ready to castigate. Not only 'The Book of Snobs' but most of his later works lash snobbism and hypocrisy. 'Vanity Fair' satirizes the social world; 'The Newcomes' is almost wholly satirical, its object being to show how men easily deceive and easily are deceived. See how through Mr. Honeyman Thackeray derides a type of clergyman; how in Barnes Newcome he hits off the acute, unscrupulous businessman; how in Clive Newcome he contemns young men at once idle and ambitious. He knew in himself the juxtaposition of these qualities, but his ambition was too unselfish for surrender to idleness. His hatred of the false, his sardonic twist of mind, the fits, from one of which he presumably died (he died in his sleep), and the melancholy outlook aggravated by his wife's incurable mania—all strengthened the satiric proclivities of his humor.

Yet he balances his satire no less than his realism. In all literature are no more happy, tender, or pathetic passages than may be found in 'Vanity Fair', 'Henry Esmond', or 'The Newcomes'. Amelia prays for George, dead on the battlefield of Waterloo, with a bullet through his heart; Lady Castlewood meeting Esmond at church, after long years, addresses him in one of the simplest, sublimest speeches woman has ever spoken; Colonel Newcome answers "*Adsum!*" as he had answered at school, and dies the most touching death in 19th-century fiction. If his satire seems to flourish at the expense of making his good people fools, and his clever people rascals, he might reply that he had looked about the world and had seen honest men fail where dishonest men succeeded. If he never felt consciously the desire to follow his preacher ancestors, he followed them unconsciously in denouncing wickedness, rather than sweetly praising righteousness.

Plots Carelessly Constructed

In his plots, Thackeray was desultory—too much so for the modern reader. Except in 'Esmond', he never made a plot. His characters led him; sometimes they led him too far astray for best results; their creator should have controlled them. He praises 'Tom Jones' for its by-play of wisdom, one feature of its exquisite construction. His own by-play, however wise and witty, follows from that regrettable habit of indolence, from a magnitude of mind and creative prolificness that balked at laborious ordering and hedging of material. Indolence and luxury, he confessed, were his dragons. Only one of his books has no single slip of idleness; that book is 'Esmond'. His purpose, not always sure, is sure in 'Esmond', intended to be his masterpiece; and it is his masterpiece, though he finally settled upon 'Vanity Fair' as his own favorite. 'Esmond' is a unit, a well-turned narrative. If, in words Trollope liked to repeat, Thackeray dropped pearls in speaking and writing, these pearls, unset, unstrung, were not best displayed for his reader. The habit of dropping pearls symbolizes his greatness; he was careless of wisdom and wasted it: all great men carelessly waste wisdom.

Realist, satiric humorist, Thackeray was not a cynic; but with Ecclesiastes he believed that all is vanity. He hated meanness; he loved loyalty and courage. Tender to children, he began 'The Rose and the Ring' to amuse a sick girl; he adopted and provided for another. He was not a good editor, sympathizing too keenly with would-be contributors whose work was poor and giving them money from his own purse. In Lord Houghton's words, he was never wroth except with wrong, a censor without Fielding's dross, with a spirit larger than that of Scott.

Books by and about Thackeray

Most of Thackeray's works were published as serial stories before they appeared in book form. This list, in which most of the titles are shortened, arranges his chief works in order of their publication: 'Catherine', 'Barry Lyndon', 'The Book of Snobs', 'Vanity Fair', 'The Great Hoggarty Diamond', 'Pendennis', 'Rebecca and Rowena', 'The Kickleburys on the Rhine', 'Henry Esmond', 'The English Humourists', 'The Newcomes', 'The Rose and the Ring', 'The Virginians', 'The Four Georges', 'The Adventures of Philip', 'Roundabout Papers'.

Books about Thackeray: 'Letters and Private Papers of William Makepeace Thackeray', 4v., edited by G. N. Ray (Harvard Univ. Press, 1945–46); and 'The Showman of Vanity Fair' by Lionel Stevenson (Scribner, 1947). Biographies for young people: 'Thackeray of the Great Heart and Humorous Pen' by Laura Benét (Dodd, 1947) and 'Young Thack' by J. R. Gould (Houghton, 1949).

THAMES (*těmz*) **RIVER.** The largest river of England, the Thames is also the most important, having as large a traffic, probably, as any river in the world. It rises in the Cotswold Hills in southwestern England, and flows in an easterly direction to the North Sea. It is about 210 miles long, and as far as London, 47 miles from its mouth, is navigable for large vessels. It is 18 miles wide at the mouth, and the tide flows up about 65 miles. Its bridges and tunnels at London, its great docks and embankments, are a part of the sights of the city. Canals connect the Thames with the Avon and the Severn, with the Sussex coast, and with the canal system of central England. From London to Oxford it is much used by rowboats, launches, and houseboats, and on any Saturday, Sunday or holiday in summer, it is sure to present a gay and festive scene. The Thames has played an important part in the history of the islands since before the invasion of Julius Caesar.

THANKSGIVING. With Indians as guests about tables loaded with game and fish, wild fruits from the forest, and corn-bread and vegetables from their new gardens, the Pilgrim Fathers celebrated their first American harvest festival, in October 1621, the first autumn of the exiles in their new home.

A quaint old account thus describes the occasion: "Our harvest being gotten in, our Governour sent foure men on fowling, so that we might after a more special manner rejoyce together after we had gathered the fruit of our labours. They foure in one day killed as much fowle as, with a little help beside, served the Company almost a weeke." Many of the Indians, among them Chief Massasoit, the Pilgrims' friend and ally, joined in the three days' feasting. There was plenty of roast turkey, for the fowlers found "great store" of the now famous Thanksgiving bird in the neighborhood of Plymouth. But in this old account there is no record to show that this was a day set apart for giving thanks.

The year following the harvest festival was filled with misfortune and the colonists had held no autumn feast. With empty larders they were counting the days until the spring-sown crops should furnish them with supplies. Then a terrible drought withered the corn in the fields and burned the gardens brown. A day of special prayer was followed by a long refreshing rain, and at the same time a ship loaded with friends and supplies was sighted. So the governor appointed a day for "public thanksgiving." But this also was different from the present Thanksgiving Day, for we find no account that tells of feasting following the long church service.

Although we read of feasts, of fasts, and of "thanksgiving days" being observed during each year, it is not until ten years later (1636) that we find record of a celebration such as we now keep. Then we read that the colonists of Scituate, in Plymouth Colony, gathered "in the meetinghouse beginning some halfe an hour before nine and continued untill after twelve aclocke," with psalm-singing, prayer, and sermon. Then came "makeing merry to the creatures, the poorer sort beeing invited of the richer."

In the course of the Revolutionary War, the Continental Congress appointed Dec. 18, 1777, to be observed generally as a "thanksgiving day" in consequence of the surrender of Burgoyne. In the first year of his office, President Washington issued a proclamation recommending that Nov. 26, 1789, be kept as a day of "national thanksgiving" for the establishment of a form of government that made for safety and happiness.

For years the festival was almost exclusively a New England institution, celebrated by religious services in the churches, the sermon being often a political address, and by the gathering at the old home of the scattered members of the family. The day gradually became a custom in the Western and some of the Southern states, each appointing its own day. In 1864 President Lincoln issued a proclamation in which he "appointed and set aside" the last Thursday in November as a day of national thanksgiving "for the defense against unfriendly designs without and signal victories over the enemy who is of our own household."

Until 1939, each president followed Lincoln's example in proclaiming the last Thursday of November a national day of thanksgiving. In that year Franklin D. Roosevelt, desiring to lengthen the interval between Thanksgiving and Christmas, named the next to the last Thursday as the date of celebration. But in December 1941 Congress passed a resolution making the fourth Thursday a legal holiday. Governors in the various states usually issue proclamations to this effect. The day is also celebrated in all the territories and possessions.

Although Thanksgiving Day is wholly an American institution, harvest festivals have been known since time immemorial. It was long customary in England and elsewhere to hold special days of "fasting and prayer" in times of peril and disaster and equally to celebrate with "thanksgiving" and feasting Nature's annual bounty and other marks of God's favor.

THEATER. In the shadow of the Acropolis, the citadel of Athens, are the ruins of the great theater of Dionysus, in which were presented the plays of the "Golden Age" of Greece. (*See* Drama.) As these great dramas remain for us one of the loftiest expressions of human genius, so the nobly proportioned Greek theater is one of the most impressive memorials of ancient architecture.

The seats of the Athenian theater, which was completed about 340 B.C., were built into the side of a hill. Thus all the spectators on the rising slope had a clear view of the "orchestra," the circle where, in the beginning, Dionysus was worshiped with choric dances. Cutting across the rear third of the orchestra was a platform about ten feet high, which in time became the stage. Across the rear of the stage extended the decorated front of the stage buildings, which took the place of a back drop and provided dressing rooms behind it for the actors.

A THANKSGIVING DAY PROCLAMATION IN THE 17TH CENTURY

This scene in a New England town of the 17th century shows us the town crier reading the governor's Thanksgiving Day proclamation before an inn, while patrons and passers-by listen attentively. The painting is by Stanley Arthurs, who is well known for his faithful re-creation of American historical scenes. From the time of the gathering of the first harvest at Plymouth in 1621, it was common for the colonial authorities to appoint a day of thanksgiving to God in the fall when the harvests were in. But there was no uniform observance of this annual festival until 1864, when President Lincoln proclaimed a national holiday.

It is interesting to note that the words used by the Greeks for the principal divisions of the theater are the same words that we use in English, slightly modified through the centuries. "Orchestra" is the Greek word meaning "dancing place," and is still used to designate the part of the theater immediately in front of the stage. The word "scenery" comes from the Greek word *skene*, used to designate the stage buildings, which served the Greeks as scenery. "Proscenium," applied to the part of the modern stage in front of the curtain, is identical with the Greek word *proskenion*, which designated the stage-front.

The theaters of the Greeks were all roofless and the performances were given by daylight, hence there was no need for artificial lighting. Changes of scene were very rare and only the most rudimentary stage machinery was employed, such as a "thunder-machine" and a crane for suspending in mid-air the actors who represented gods. In order that the voices of the actors might be heard in all parts of the vast theater, they wore masks equipped with a sort of megaphone. In tragedy those who represented the great legendary characters wore in addition a shoe or "buskin" with stiltlike soles to increase their height.

The theaters of the Romans were copied from the Greek structures, with certain variations and improvements. By the use of supporting arches they were able to build great sloping theaters, instead of using hillsides as the Greeks did. Since the chorus disappeared from most of their plays, the orchestra was no longer needed for the performance, and senators and other persons of note were seated here. At the same time the stage was lowered and enlarged, so as to accommodate more players. Decorations were often very lavish. Gold, marbles, fine textiles, and a system of cooling the interior of the building by means of aqueducts made the Roman theater a luxurious place of recreation.

Vast Theaters of Olden Times

For special performances temporary theaters were often built on an astonishingly extravagant scale. One such theater is said to have held 80,000 people, and to have had 360 pillars and 3,000 statues. The chariot races, gladiatorial fights, and combats with wild animals took place in such structures as the Circus Maximus of Rome, and the amphitheaters (like the Colosseum at Rome) which sprang up all over the Roman Empire.

All the grandeur of Roman theaters and amphitheaters was destined to be buried and forgotten for hundreds of years. As dramatic art grew more corrupt and debased and the circus grew more brutal, the power of the rising church was exerted against it, until finally all theatrical and kindred performances were forbidden. In the course of the Middle Ages the arenas and the amphitheaters scattered throughout the Roman world were filled with buildings used for shops and houses.

During the Middle Ages there were no theaters in the proper sense. Open-air performances were given in churchyards, in booths, or in two-storied wagons called pageants. Jugglers and mountebanks performed in the public squares and after some time strolling bands of players gave performances in courts of inns and taverns. The common people stood during the performances, but the wealthier patrons looked down from their windows and balconies.

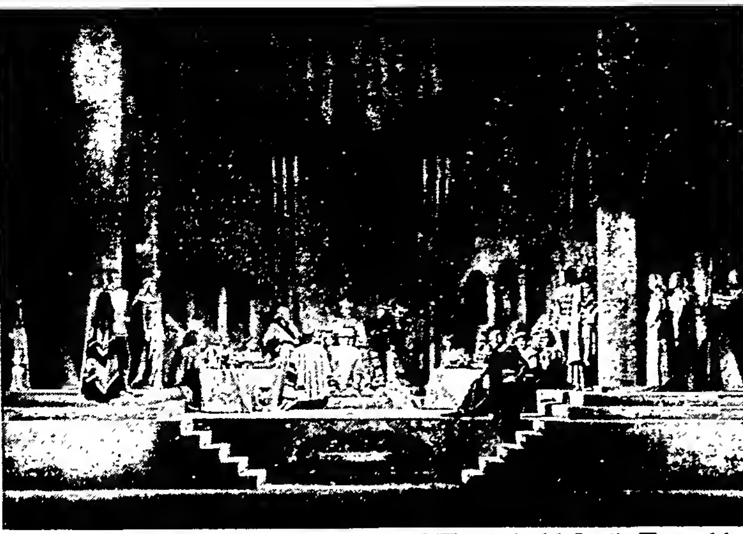
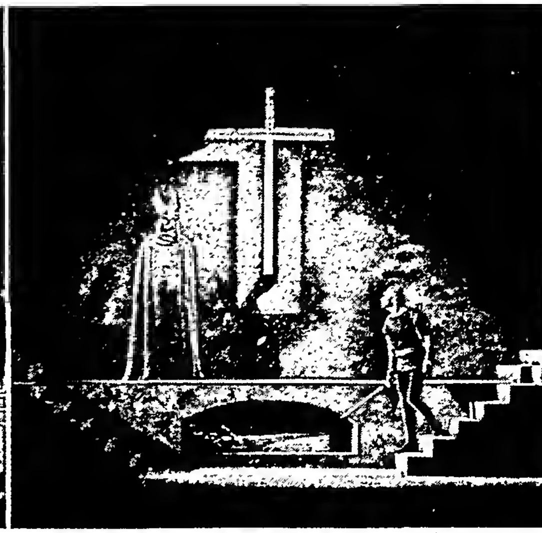
Great Dramas in Crude Theaters

The theaters of Shakespeare's time were built in imitation of the inn-court. They were eight-sided, for the most part, with a raised stage built across one of the sides, and extending into the body of the house. Favored spectators sat on its edge or in the three-storied covered balconies that extended all the way around the building, even behind the stage. The "groundlings," as Shakespeare called the people in the "pit," stood during the performance and were unprotected from the weather. Flags were flown above the buildings as a sign that a play was on.

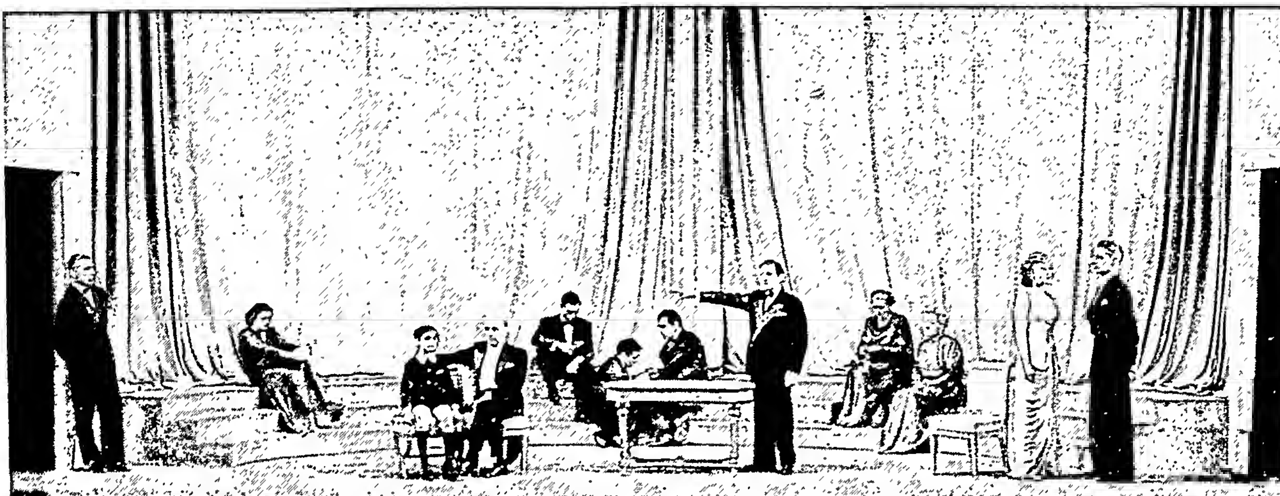
At the back of the stage were dressing-rooms and a curtained recess used for such scenes as the play within the play in 'Hamlet' and Desdemona's chamber in 'Othello'. The performance was always given by day, so that there was no lighting. Scenery was very simple and there was no curtain.

The public theaters during the reigns of Queen Elizabeth I and James I were not attended by women. If the court wished to see a performance, the company was "commanded" to appear in a palace hall. The form of entertainment which the higher classes preferred was the masque, which resembled the pageant of our day. These masques were given in the great halls of colleges, palaces, and other large buildings. Candles were used for lighting, seats were placed on the floor, and the balconies, if there were any, were used for guests of honor. After a while theaters were built expressly for these masques. The first one was that of the Blackfriars, where the choir boys of St. Paul's gave performances. Painted scenery was used and the entire production became very elaborate, thus foreshadowing the opera. The modern English playhouse is a direct descendant of this Blackfriars Theater, with the addition of features brought in by way of France and Italy.

The tendency throughout the 17th and 18th centuries was toward extreme elaboration. In Italy opera-houses grew more and more luxurious in scenic effects. In the 19th century such famous opera-houses as La Scala at Milan and San Carlo at Naples were built on a still greater scale. France, Germany, England, and America followed the example. Scenery and stage apparatus were enormously improved, until we get such amazingly equipped theaters as the famous Royal Opera House, Covent Garden, of London. This stage is divided into six sections which may be lifted or lowered by electrical power. Overhead is a bewildering maze of pulleys, cables, and wires controlling scenery and lighting. In some places there are revolving stages so that one-half may be used while the other half is being set.

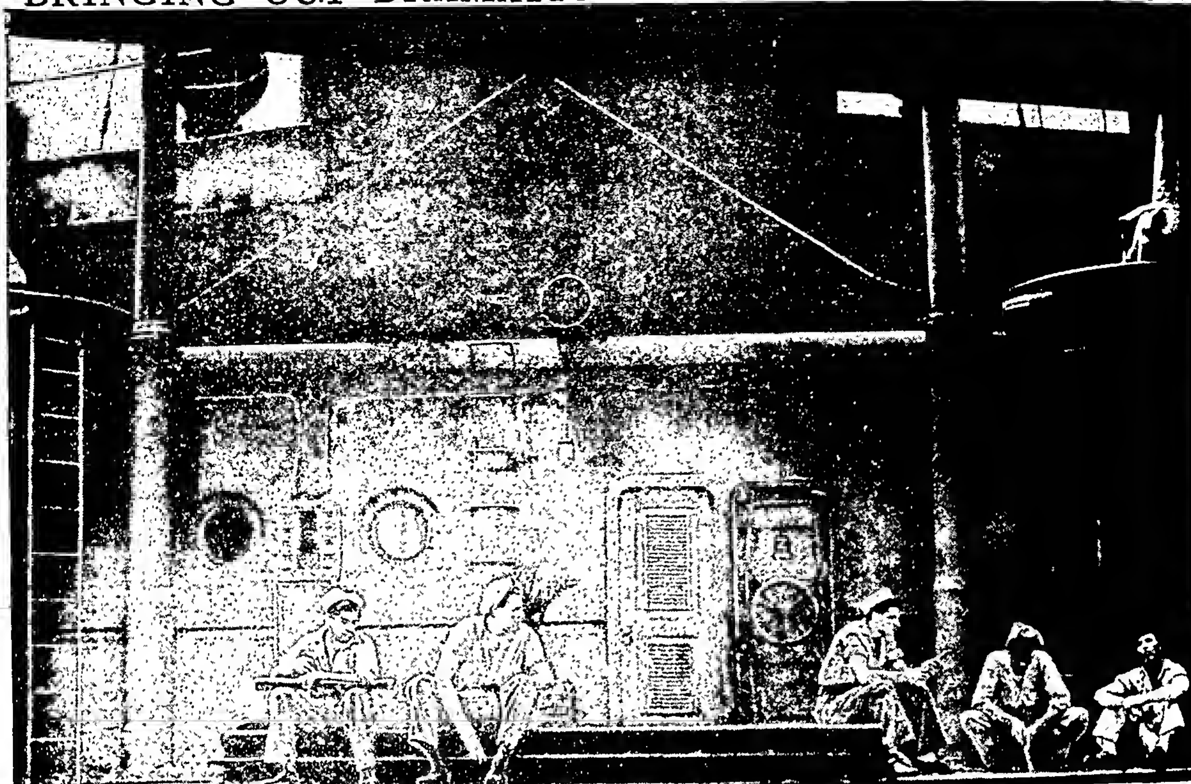



These two pictures are from a production of 'Hamlet' with Leslie Howard in the title rôle. The platforms, steps, and arches suggest the castle at Elsinore. The same basic set was used for nearly all action. At left, lighting and a few "props" give the impression of a throne room. At right, the set is stripped to create the battlement where Hamlet meets his father's ghost in Act I.



'Antigone', the great tragedy by the Greek dramatist, Sophocles, is given here in modern dress and setting. Simple draperies form the backdrop. The actors wear evening clothes. This use of modern clothes and setting emphasizes that the essential theme of 'Antigone' is as true of life today as in ancient times. The star, Katharine Cornell, is seated on the steps at the left.

The production 'Lady in the Dark', with Gertrude Lawrence (left) and Danny Kaye (right), required two revolving stages for quick scene changes. Outlines of the revolving units can be seen on the large stage floor. The curtain was never drawn during scene changes.



To accent the realism of 'Mr. Roberts', a play about life on shipboard during the second World War, the designer provided a close replica of a navy cargo vessel. The set was rich in detail, and the men wore clothes typical of seaman garb in the Pacific.

This setting for 'A Streetcar Named Desire' shows with quick and fanciful touches the interior of a run-down apartment in New Orleans. Notice how lighting picks out the two centers of action, one in the center and the other on the winding staircase at the left.

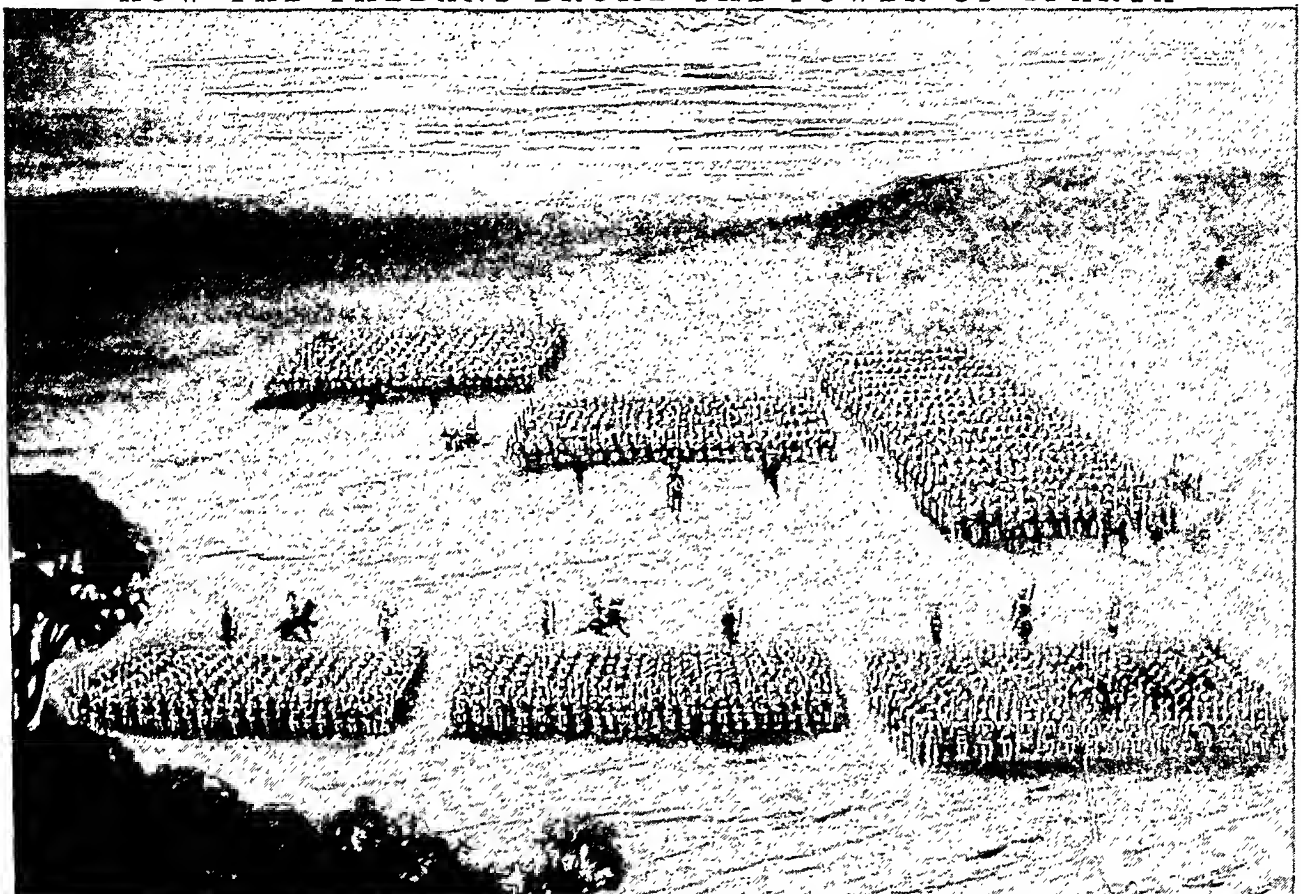
Through the latter half of the 19th century the tendency persisted to make performances more and more spectacular; settings and costumes became still more complex and gorgeous and elaborate. A counter-tendency set in during the last decade of the century in the direction of simplification and the substitution of symbols for elaborate realistic imitations. Gordon Craig in England, Max Reinhardt in Germany, Leon Bakst in Russia, and the leaders of the Irish theater movement accomplished amazing results by the use of the simplest decorations and settings, relying chiefly for their effects on the skilful use of lighting. The work of these men has been felt in the United States in the various "Little Theaters" scattered through the country, which have followed in the steps of the pioneers of their new stage art.

Thebes (*thēbz*), **Greece**. An insignificant little country town of 12,582 people (1951 census), 44 miles northwest of Athens, stands today on the spot which was once the seat of one of the oldest and greatest powers of Greece, the "seven-gated city of Thebes." Only a few ruins are to be seen today on the Cadmea, the acropolis of ancient Thebes, so called after Cadmus, the mythical founder of the city (*see* Cadmus).

Thebes lies in the central part of Boeotia in eastern Greece, a region of fertile and well-watered soil but heavy fog-laden atmosphere. The Boeotians were said by their Athenian neighbors to be as dull as their native air and their stupidity passed into a proverb. Nevertheless they produced such writers as the poet Pindar and the biographer Plutarch and many warriors who achieved glory in battle.

Her historic past—about which grew up a group of legends scarcely less interesting than the Trojan cycle—her central location, and her strong fortifications made Thebes chief among the cities of Boeotia. As such she frequently came in conflict with Athens, and when rivalry between Athens and Sparta finally culminated in the Peloponnesian War (431–404 B.C.), Thebes sided with Sparta. After the war was ended, however, Thebes became Sparta's bitter foe, because of the arbitrary and tyrannical policies of her former ally. After numerous conflicts, the Thebans expelled the garrison which the Spartans had by treachery put in possession of the Cadmea, killed the leaders of the pro-Spartan party, and formed a combination of Greek states against Sparta. The Spartans met military reverses, and soon signed a peace with all

HOW THE THEBANS BROKE THE POWER OF SPARTA



At the battle of Leuctra, in 371 B.C., the Theban leader Epaminondas devised a military maneuver which routed the dreaded Spartan phalanx. The Spartans as usual drew up their forces in three masses, with the strongest on the right. To oppose the right Epaminondas consolidated the bulk of his army, 50 shields deep, while his weaker center and right he withdrew slightly, so that they would not come into contact with the Spartans until after his powerful left had crushed the Spartan right. The plan worked out exactly as he had planned. The Spartans were routed, more than half of their number were slain, and the power of the Spartan state was broken forever.

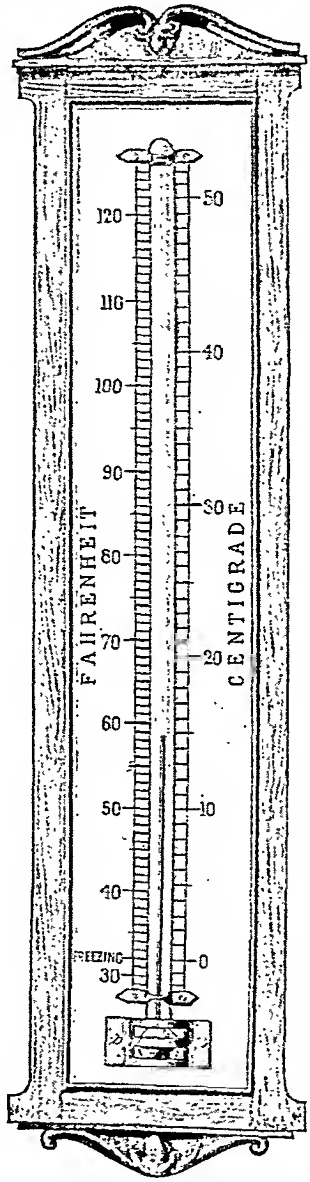
their foes except Thebes, which was left unaided to bear the onslaught of the dreaded Spartan phalanx. This tactical device consisted in drawing the heavy-armed infantry up in a solid mass eight or twelve men deep, so that the onrush flowed unbroken through the hostile lines, like a mass play in the modern game of football.

But the Theban commander Epaminondas—perhaps the noblest and most famous Greek of his day—devised an effective answer to this famous Spartan "play," which he used when he met the foe in 371 B.C. on the plain of Leuctra, about eight miles from Thebes. Epaminondas arrayed his choicest troops on the left, 50 shields deep, directly opposite the right wing of the Spartans, where they had massed as usual their heaviest force, 12 deep. His shallower and weaker center and right wings he kept drawn up so that each line was to the right and rear of the preceding one, and thus held them in reserve while the massive Theban left drove against the Spartan right and crushed it. Then the Theban center and right coming into action completed the rout. Over half the Spartans engaged were slain and Spartan power was ended.

For nine years Thebes held the supremacy of all Greece, but its power was based on the genius of a single man and collapsed with his death at the battle of Mantinea (362 B.C.). Here Epaminondas once more saw his phalanx break the Spartan line, but as he pursued the retreating foe, he was pierced in the breast by a javelin. He was told by his physician that he would die as soon as the weapon was extracted. When news came that the victory was secure, he drew out the javelin with his own hand, saying, "I have lived long enough."

When Philip of Macedon invaded Greece a few years later, Thebes joined forces with Athens, influenced by the eloquence of the orator Demosthenes, and made a brave but unsuccessful stand in the decisive battle of Chaeronea (338 B.C.), bearing the brunt of the attack. At the accession of Alexander the Great to the Macedonian throne, Thebes attempted to recover its liberty, and was leveled to the ground in punishment. Though later rebuilt, it never again was an important city. The present town of Thebes is called Thevai in modern Greek.

The Greek Thebes must not be confused with the Thebes of ancient Egypt (*see* Egypt, Ancient).



On this house thermometer designed to show changes in temperature of the air indoors, you can readily compare the Fahrenheit and Centigrade scales.

THERMOMETER. The commonest thermometers are those in which the degree of heat is indicated by the expansion of a liquid. The ordinary household or industrial thermometer consists of a glass tube enlarged at the bottom into a bulb and partly filled with mercury. The bore of the tube is extremely fine (from about a fiftieth to a thousandth of an inch) so that a small amount of expansion or contraction of the mercury in the bulb will produce a relatively large rise or fall of its level in the tube. The thick curved face of the tube then acts as a magnifying glass to make the thin thread of mercury plainly visible. In the making, the mercury is ordinarily driven by heat to the top of the tube which is then sealed off, resulting in a vacuum when the mercury contracts again. For the higher temperatures, however, the tube is filled with gas (nitrogen or carbon dioxide) under high pressure to prevent the mercury from boiling. Alcohol colored red is used in climates or processes where the temperature falls below the freezing point of mercury (38° below zero Fahrenheit).

The Fahrenheit scale, popularly employed in all English-speaking countries, uses as its zero point the temperature of a mixture of ice, salt, and water. The freezing point of water is 32° above zero and the boiling point 212°. In the Reaumur scale, formerly popular in Europe, the freezing point is marked zero and the boiling point 80. The most convenient system, however, and the one used in scientific work the world over, is the Centigrade scale, in which the freezing point is zero and the boiling point 100°.

To change a reading from Centigrade scale to Fahrenheit *first multiply* by $\frac{9}{5}$ and then add 32. To change Fahrenheit to Centigrade *first subtract* 32 and then multiply by $\frac{5}{9}$. Thus 20° C. is 20 times $\frac{9}{5}$, plus 32, or 68° F.; and 68° F. is 68 *minus* 32, times $\frac{5}{9}$, which equals 20° C.

Mercury thermometers for special uses are made with scales up to about 1,000° F. One of the most familiar of the special types is the *clinical thermometer* with which physicians take temperatures. It reads from 93° to 110° F., the normal temperature of the human body being between 98° and 99°. To allow the doctor to read it accurately even after it starts to cool, there is a small constriction in the bore of the tube where the thread of mercury breaks instead of running back. It stays in position until shaken down. One side of the tube is prismatic to magnify the mercury thread for easy reading.

Thermometers that ring alarms, turn off the heat, or start or stop machinery at desired temperatures are made by inserting the ends of electric wires in bulb and stem. As the rising mercury meets the upper wire, it automatically turns on the current. When such a device is used to regulate heat, it is called a *thermostat* (*see* Heating and Ventilating).

Most solids as well as liquids expand when heated. This gives us another kind of thermometer. If we fasten together a strip of brass and a strip of iron and heat them, the compound bar will bend because brass expands more than iron. The amount of this bending can be indicated on a scale. Recording thermometers or *thermographs* sometimes work on this principle. A pen controlled by the movement of the end of the bar traces a record of the rise and fall of temperature on a disk or drum revolved by clockwork. The bending bar can also be used to open and close an electric circuit at a given temperature. The commonest thermostats employ this principle.

For high temperatures as well as for extremely delicate measurements, expansion thermometers are impractical. Here electric thermometers play a leading part. Heat increases the resistance of certain metals to the passage of an electric current and a device for measuring this changed resistance is a good gauge of temperature. Another type of electric thermometer uses what is called a *thermocouple*, consisting of a loop made of wires or rods of two different metals joined together. When one joint gets hotter than the other an electric current is generated in the loop which is proportional to the difference in temperature (*see* Electricity). A measure of this current is an extremely accurate indication of the degree of heat in question. When a number of "couples" of metals are connected in series, with one set of joints exposed and the other shielded, the device is called a *thermopile*. The heat coming from a single star has been measured with such an instrument. Electrical thermometers used for high temperatures are classed as *pyrometers* (*see* Pyrometer).

The earliest attempt to build a thermometer on scientific lines is said to have been made by Galileo. The sealed tube thermometer as we know it today first came into practical use in the 17th century. The word "thermometer" is from the Greek, meaning heat measurer.

THERMOPYLAE (*thẽr-mŏp'ē-lē*). In this pass leading from northern to central Greece, King Leonidas of Sparta made his famous stand against the mighty army of King Xerxes of Persia in 480 B.C. With 300 Spartans he held the pass until the treacherous Ephialtes, a Thessalian, showed the Persians an unguarded path over the mountains, and allowed them to attack the Spartans in the rear. Here again, in 279 B.C., the Greeks held at bay an army of Gauls until these, too, found a way over the mountains.

Thermopylae means "hot gates" and takes its name from remarkable hot springs near by, which still exist. Besides one large spring used as a bath there are four smaller ones; the water, which is of a bluish green color, is believed to have curative properties. The once narrow pass between Mount Oeta and the sea has been greatly widened through the centuries by the deposits of streams. In 1939 Greek archeologists excavated spears and a vast number of arrowheads. This supports the statement of Herodotus that the number of the Persians was so great that their arrows obscured the sun. (*See* Persian Wars.)

THESEUS (*thē'sūs*). The greatest legendary hero of Athens was Theseus, said to have been the son of Aegeus, king of Athens. He was born and brought up in a far distant land, and his mother did not send him to Athens until he reached young manhood and was able to lift a stone under which his father had put a sword and a pair of sandals.

Arriving at length, after many dangers and adventures, Theseus found the city in deep mourning because it was time to send to Minos, king of Crete, the yearly tribute of seven youths and seven maidens to be devoured by the Minotaur, a terrible monster, half man, half bull. Theseus offered himself as one of the victims, hoping that he would be able to slay the monster. When he reached Crete, Ariadne, the beautiful daughter of the king, fell in love with him, and aided him by giving him a sword with which he killed the Minotaur, and a ball of thread by which he was able to find his way out of the winding labyrinth where the monster was kept. But he forgot the promise he had made to his father that if he succeeded in his undertaking he would hoist white sails on his ship when he returned, instead of the black ones with which the vessel had set out. The king, seeing the dark sails returning, and thinking that his son was dead, cast himself into the sea, which has since been called, after his name, the Aegean. Theseus now became king of the Athenians, and united the various village communities of the Attic plain into a strong and powerful nation. Many other brave deeds were ascribed to him. He was said to have been one of the Argonauts who went in search of the Golden Fleece, and in a war against the Amazons he conquered these famous women-warriors. He was once engaged in a contest of arms with Pirithoüs, king of the Lapithae, but the two heroes were so filled with admiration of each other that they swore eternal friendship. Theseus came to the aid of Pirithoüs in his struggle against the Centaurs (*see* Centaurs).

Theseus was killed by treachery during a revolt of the Athenians. In later times his memory was held in the greatest reverence, and at the battle of Marathon (490 B.C.) many of the Athenians fancied that they saw his spirit, clad in armor, charging at their head against the Persians. After the Persian Wars the oracle at Delphi ordered the Athenians to find the grave of Theseus on the island of Syros, where he had been killed, and to bring back his bones to Attic soil. The oracle's instructions were obeyed. In 469 B.C. the supposed bones of Theseus were carried back to Athens, and the tomb of the great hero became a refuge for the poor and oppressed of the city.

THE INCIDENT THAT LAUNCHED A 30-YEAR WAR

This picture, based on a painting by Vaclav Brozik, shows enraged Protestants throwing the royal representatives from a window of the royal castle at Prague. The victims plunged more than 50 feet to the castle moat below, but miraculously escaped with their lives.

THIRTY YEARS' WAR. When Ferdinand II, on the eve of his election as Holy Roman emperor, said that he would rather rule over a desert than a heretical kingdom, his words were prophetic. They helped to start the Thirty Years' War (1618–48), which left Germany in ruins. Though the immediate cause of the war was the bitter hatred between the Catholic and Protestant princes of the empire, other factors soon dominated the tragic drama, and before the final curtain fell most of northern Europe was involved.

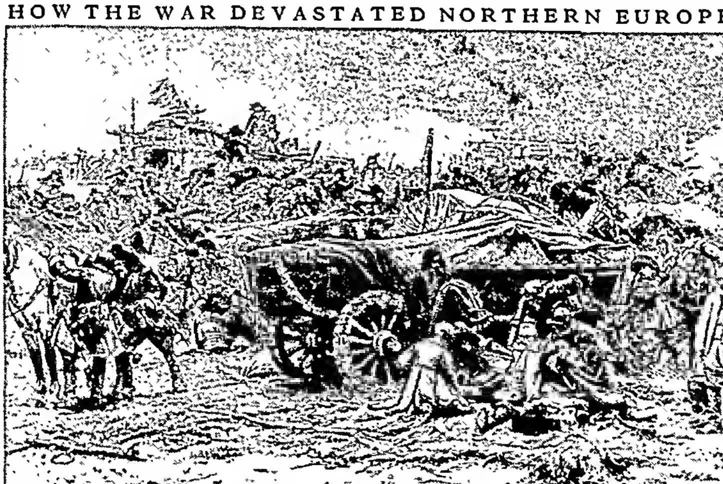
The tragedy was enacted in four phases. It opened in Bohemia with the revolt of Protestant leaders against Ferdinand, and their subsequent defeat. Act two began with the intervention on the Protestant side of Denmark aided by Holland and England, and ended with the defeat of the Danish army. In the third act, Gustavus Adolphus of Sweden appeared as the champion of the Protestant cause in a struggle which had already lost so much of its religious significance that Catholic France supported him. In this phase, victory for the opponents of the emperor turned into defeat after Gustavus Adolphus was killed in battle. The fourth and last act saw France openly taking the leadership in the struggle against the imperial power. It closed with military and political triumphs for the French, the end of the Holy Roman Empire as a political force in Europe, and the economic ruin of Germany.

Events of the War —Bohemian Revolt

The Peace of Augsburg in 1555 had left the German states of the Holy Roman Empire divided into two hostile groups—Lutheran and Catholic (*see* Reformation). A third group, the Calvinists, had been shut out from the advantages granted to the Lutherans by this peace. As a result, they hated and were hated by the Lutherans. Nevertheless, as the Catholic reaction against the Reformation gained ground, Lutherans and Calvinists joined in 1608 in forming a Protestant Union. In reply, the Catholic League was formed the following year. Sooner or later, war was inevitable.

Before Ferdinand II became Holy Roman emperor he was first regent and then king of Bohemia. It was in this capacity that he brought on the Bohemian rebellion in 1618. Its leaders renounced allegiance to him and chose for their king the Palatine elector, Frederick V, a Calvinist. Frederick failed to unite the Bohemian people, and the country became an easy prey for the plan to wipe out Protestantism there and annex the state to the Austrian crown. The Lutheran princes of the Protestant Union refused to help Frederick, a mistake they were to regret in later years. He was defeated at the battle of White Mountain in 1620 by a Bavarian army under the Count of Tilly, commanding general of the Catholic League. The Protestant Union was dissolved, and Bohemia was stripped and beggared.

HOW THE WAR DEVASTATED NORTHERN EUROPE



This old illustration depicts a typical scene from the Thirty Years' War. In the right foreground, a wounded commander is being attended by his followers, and in the background, armies sweep onward with firebrands to destroy what is left of a burning town. The war left thousands homeless.

The Danish Period of the War

With Frederick powerless and banished, this was Ferdinand's opportunity to make peace with the Protestants and save his country. Instead, he insisted

that his real objective, the extermination of heresy, was still to be attained. This attitude, and the persecutions which he instigated, aroused the Protestant rulers of England, Holland, and Denmark, and they sent an invading army under the leadership of King Christian of Denmark to oppose the Austrians.

Between the years 1625–29 the Danish army was defeated and driven out of Germany, and the Protestant forces were completely routed. This victory was accomplished in part by Tilly's army, but the large force of mercenaries and adventurers raised by the brilliant new general, the Duke of Wallenstein, was the deciding factor. His men roved the country at will, pillaging wherever they went, and depredations, torture, and death were the order of the day. In 1630 floods of complaints from every part of Germany forced Ferdinand reluctantly to dismiss Wallenstein.

Exhausted by the conflict, both sides were glad to join in the short-lived Peace of Lübeck in 1629 This opportunity to end hostilities was again nullified by the emperor, who signed the Edict of Restitution, forcing all Protestants to relinquish any Catholic church property acquired since 1555. Religious hatred again came to the boiling point.

The Period of Swedish Leadership

The Austrian emperor now reigned from the Adriatic to the Baltic, and Cardinal Richelieu, prime minister of France, was eyeing his successes with increasing anxiety. The "Iron Cardinal" adroitly persuaded King Gustavus Adolphus of Sweden that, with the help of subsidies from France, he could and should protect his boundaries from the aggressors and aid the Protestant cause (*see* Gustavus Adolphus).

The Swedish king invaded Germany in 1630, and his army was augmented by thousands of homeless and desperate Germans. Unhappily he came too late to prevent the horrible sacking and burning of Magdeburg by Tilly's men, but he attacked and defeated them in the famous battle of Breitenfeld in 1631, leaving Tilly with only a remnant of his army alive.

Swedish successes continued until, in 1632, Ferdinand was faced with the fact that his cause was lost unless he recalled Wallenstein. He did so under terms that virtually made the general dictator of Germany. In the same year Wallenstein raised another army and met the advancing Swedes in the battle of Lutzen, where Gustavus Adolphus was killed.

After the death of the Swedish king, the advances of his army were checked. But the fighting went on, back and forth over the ravaged land, until the German people neither knew nor cared who was winning. With equal terror they watched the approach of their own or the enemy's army.

France Brings the War to a Close

In 1632 Tilly was mortally wounded fighting the Swedish forces on the Lech; but Wallenstein drove them back late in 1633. He was assassinated in 1634 after plotting to make peace. Richelieu realized he would have to send troops into the war if France was to keep the place of pre-eminence he had won for it in Europe. He sent troops under the able generals Turenne and Condé, and with their arrival the tide turned against the emperor. For the next fourteen years the fighting went on over the war-torn country. Ferdinand II died in 1637, but the struggle went on under his son, Ferdinand III. Germany was the victim of indescribable depredations by its own armies and foreign enemies alike. As the French were preparing for the siege of the city of Prague in 1648, word came that the Peace of Westphalia had been signed on Oct. 24, 1648. Properties and authority were returned to the Protestant princes of Germany. Spain by the separate Treaty of Münster recognized the independence of the Netherlands. Sweden obtained extensive territories on the German coasts of the Baltic and the North Sea. France acquired Alsace, and, although Richelieu had died in 1642, he had laid the foundation for the French domination of Europe under Louis XIV, who came to the throne the year after the cardinal's death.

PRELUDE TO PEACE—THE TREATY OF MÜNSTER

This engraving, based on a painting by Gerard Terborch, shows the Dutch (left) and the Spanish emissaries (right) ratifying the Treaty of Münster (Jan. 30, 1648), which recognized the independence of the United Provinces. The Treaty of Westphalia that finally ended the war was not signed until Oct. 24, 1648.

Effects Resemble Those of Second World War

But the people of Germany were left in a state of spiritual, moral, and intellectual degradation comparable only to the effects of the second World War. Education had been discarded and agriculture virtually wiped out. The population was so reduced that there was no one to rebuild the cities or replant the fields. No gifts of food or clothing or medicines came to succor the survivors. For many years ruin and despair were their only companions.

THE NATIONAL EMBLEM OF SCOTLAND

The spear thistle (*Cirsium lanceolatum*) seems to be the original Scotch thistle. That honor is also claimed for other thistles, but this spiny variety appears to have the best claim.

THISTLE. When King Alexander III was king of Scotland, 1241–85, King Haakon of Norway landed an army on the shores of that kingdom and attempted to conquer it. But in his night attack on the Scottish camp at Largs, a barefoot Norseman trod on a thistle and cried out in pain. The Scots took the alarm, the attack failed, and soon afterward King Haakon had to withdraw his army and surrender the Hebrides Islands to Scotland. In remembrance of the battle of Largs, the Scots adopted the prickly purple thistle for their national emblem. In 1540 an order of knighthood, called the "Order of the Thistle" or "Order of St. Andrew," was established by King James V of Scotland.

Several varieties of this vigorous plant are distributed over the United States. They are mostly weeds, although many of them, with their stout stems and spiny leaves surmounted by soft silky flower heads of purple, pink, yellow, or white, are very handsome. They are very hard to eradicate, however, and are a source of never-ending annoyance to the farmer. The Canada thistle especially—known also as corn thistle, creeping thistle, and Scotch thistle—is a great nuisance in the New World, to which it has found its way from the Old. This variety grows from one to three feet high and has small rose-colored flowers. Like all thistles, the flower heads form large downy seed balls, which the wind scatters far and wide. The long fleshy underground stems, found just below the level usually reached by the plow, are hard to tear out, and any little piece of root left in the ground will form a new plant.

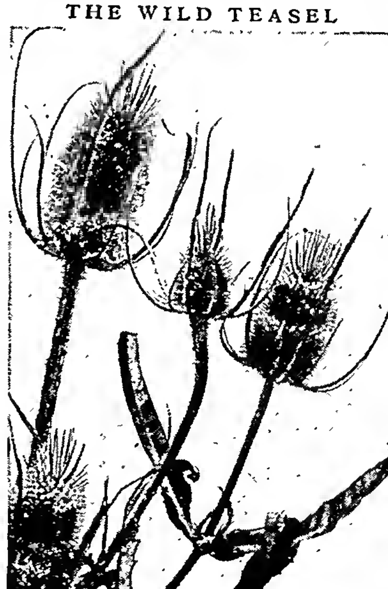
The beauty of a few varieties of thistle has won for them a place in many gardens, particularly the blue-flowered globe thistle, and the cotton thistle, a tall branching plant with large spiny leaves covered with white cotton-like hairs. The latter variety grows wild in some parts of the United States. The milk thistle is sometimes cultivated for its root stalks, which are eaten like salsify.

The teasel, a native of southern Europe, but cultivated in the United States and elsewhere, is widely used in cloth-making. The heads are cut off when in flower and dried. Their oblong hook-pointed prickles are used for "fulling" or raising the nap of cloth, and do the work better than any mechanical device which has been so far invented.

A number of plants similar to the thistle are sometimes called by that name, among them the spiny Russian thistle or tumbleweed, a curious and common plant of the western United States.

Scientific name of Canada thistle, *Cirsium arvense;* of the fullers teasel, *Dipsacus fullonum.* The *Cirsium lanceolatum* seems to be the prototype for the national emblem of Scotland but claims are made for the cotton thistle, *Onopordon acanthium.* (For illustration in color, *see* Flowers.)

THE WILD TEASEL



The teasel does not belong to the thistle family, but in general use it often gets the name. One species, called the fullers teasel, is cultivated because its heads are set with hooked spines and are used for "fulling" or raising the nap on woolen goods.

THOMAS, GEN. GEORGE HENRY (1816–1870). "The Rock of Chickamauga" was the title given to General Thomas because of the steadfastness with which he held his position on that famous battlefield in the Civil War. This steadfastness of courage and purpose made him a great general even in the midst of defeat.

A Virginian by birth, he received his military training at West Point, graduating in 1840 as a classmate of Gen. William T. Sherman. His first military experience was gained in campaigns against the Indians and in the Mexican War. On the outbreak of the Civil War, he decided after much hesitation to remain loyal to the Union. He was made a brigadier general and was sent into the Shenandoah Valley of Virginia to aid the Unionists of that region. Soon he was transferred to Kentucky, where he defeated the Confederate forces in January 1862. For this victory he was promoted to the rank of major general of the volunteer army.

General Thomas' remaining service in the Civil War was all in the West. During the battle of Murfreesboro, or Stones River, Tenn., he rendered great service, showing his characteristic quality of steadfastness. At Chickamauga (Sept. 19–20, 1863)—one of the fiercest battles of the war, involving Union losses of 16-000 and Confederate

losses of 18,000—when the Union right was routed and General Rosecrans, the commander, gave up the field for lost, General Thomas held his position on the left against repeated attacks of the victorious Confederates, thus saving the army. In the battle of Missionary Ridge (Nov. 25, 1863) his troops carried the enemy's rifle pits at the base of the ridge, scaled the heights, and captured the Confederate lines on the crest.

During the Atlanta campaign, which ended in the capture of that city, Thomas rendered conspicuous service. When Sherman started on his march through Georgia, he left Thomas to oppose the Confederate army under General Hood, who moved into Tennessee. Thomas hurried to Nashville, but when his opponent appeared before that city he delayed to attack, taking time to organize and equip the new troops that had been sent to him. Fault was found with him for his slowness to act, and an order was given for his removal. Before the order reached him, however, General Thomas had attacked and completely crushed Hood's army, on Dec. 15–16, 1864, winning one of the important victories of the Civil War. For this victory he received the thanks of President Lincoln and of Congress, was promoted to major general in the regular army, and was given a medal by the state of Tennessee. (*See also* Civil War, American.)

After the war General Thomas remained in the army and was in charge of several military districts. He declined the rank of lieutenant general, which was offered him, saying that he had done nothing since the war to merit promotion.

No officer in the Civil War inspired in his men a greater measure of enthusiasm and personal devotion than "Old Pap" Thomas, as he was affectionately called by his soldiers; and as a commander he showed qualities of the highest order.

THOR. Ages ago, according to the myths of the Northland, there lived a powerful young god named Thor. It was he who chased away the frost and called gentle winds and warm spring rains to release the earth from its bondage of ice and snow. The lightning's flash was his mighty hammer Mjölnir, hurled in battle with the frost giants, and the rolling thunder was the rumble of his fiery chariot.

I am the god Thor,
I am the war god.
I am the Thunderer!
Here in my Northland,
My fastness and fortress,
Reign I forever!

Here amid icebergs
Rule I the nations;
This is my hammer,
Mjölnir, the mighty;
Giants and sorcerers
Cannot withstand it.
—*Longfellow.*

Thor was a good-natured, careless god, always ready for adventure, and never tired of trying his great strength. He could shoulder giant oaks with the greatest of ease and slay bulls with his bare hands. For sport he sometimes rode among the cloud-veiled mountains, hurling his hammer at their peaks and cleaving them in twain.

This daring god once visited Jotunheim, land of the frost giants. Utgard-Loki, king of the giants, looked at him scornfully and said: "Is this stripling the mighty god Thor? Perhaps you are mightier than you appear. What feats do you deem yourself skilled in?"

"I will test my prowess in a drinking bout with anyone," said Thor, his eyes flashing fire.

THE STRONGEST OF NORSE GODS IN ACTION

The mighty Thor on his thunder chariot prepares to hurl his lightning hammer Mjölnir. He wears a magic belt to double his strength. His iron gloves will magically guide the hammer straight to the skull of some frost giant. Then the hammer will fly back to Thor.

The king thereupon bade the cupbearer bring a drinking horn and said: "Whosoever is a good drinker is able to drain this horn at a single draught." Thor placed the horn to his lips and drank long and deep, but when he removed it the liquid had scarcely diminished. Three times he tried to empty the horn and failed, and at last he threw it down in disgust.

Next he attempted to lift the king's cat from the ground, but only succeeded in raising one of its paws. The giants jeered at him and shouted to one another, saying, "Is this the mighty god whom we have been taught to fear?"

Thor then offered to wrestle with anyone who would stand against him, and a toothless old woman accepted the challenge. With mad rushes Thor

attempted to throw the old crone to the floor, but in spite of all his efforts could not succeed. In shame he left the palace. When he was safely outside its gates, Utgard-Loki came to him and said: "O mighty Thor, when you attempted to empty the drinking horn you performed a feat so marvelous that, had I not seen it myself, I should never have believed it. The sea itself lay at the end of that horn, and when you come to the shore you will see how much of the waters have fallen away. Terror overcame me when you lifted the cat's paw from the floor, for that cat is the serpent Midgard, who encircles the earth, and the whole world shuddered when its hold was loosened. To stand against the old crone for so long a time was marvelous, for it was indeed Old Age with whom you wrestled, and no man may conquer her. Magic, and not the prowess of the frost giants, has overcome you."

Thor, in wrath at being so tricked, reached for his hammer, but before he could throw it the giant disappeared. This is only one of the many stories told of Thor. Anglo-Saxon peoples called him Thunor, and from this has come the English name for the fifth day of the week, Thursday.

THOREAU (*thō-rō'*), **HENRY DAVID** (1817–1862). At the age of 28 Henry Thoreau, Harvard graduate and carpenter, scholar, and woodsman, resolved to simplify his life. He felt that he was paying too dearly for his livelihood. "The cost of a thing," he wrote, "is the amount of what I will call *life* which is required to be exchanged for it"; and Thoreau decided that the various employments he had tried his hand at—surveying, carpentry, school-teaching, pencil-making—all took more of his life than he was willing to exchange for a living.

"To maintain one's self on this earth is not a hardship but a pastime, if we will live simply and wisely," he said; and acting on this theory he went off to see how cheaply he could live on the shore of Walden Pond, near his native town of Concord, Mass. He borrowed an ax and built a cabin with a capacious fireplace. He cleared a little patch of ground and raised beans, peas, potatoes, and sweet corn. Such money as he needed to buy clothing and the foodstuffs he could not raise, he obtained by selling some of his vegetables and by working at one of his trades for six weeks during the summer. By thus reducing the machinery of life to its lowest terms, Thoreau supported himself for two years at an average cost of 27 cents a week, and of only six weeks' paid labor out of the 52 weeks of the year.

He has left us an account of his experience in his 'Walden', one of the most interesting and stimulating works in American literature. Nature and great books were the things he chiefly loved, and the leisure he won by simplifying his life he spent in thinking and writing. He got close to the life of the animals, which loved him as he loved them. The birds, forgetting their fear of man, came at his call; the beasts were his friends; even fish swam unafraid to his hands.

When Thoreau had had enough of this lonely life, he quietly returned to Concord and spent his remaining days there, writing much, sometimes lecturing or making pencils for a living. He died of tuberculosis at 45, despite his open-air life.

THOREAU

The Sage of Walden Pond

Fond of solitude as Thoreau was, he had a few close friends, of whom Emerson was one of the closest. In manner he was outspoken, he made no effort to please, and to many appeared cold; but those who penetrated beneath the outward appearance found in him warm sympathy, cheerfulness of disposition, a high and deep spirituality, and the wisdom that comes to those who have lived close to reality.

Emerson sums up his life in these words: "He was bred to no profession; he never married; he lived alone; he never went to church; he never voted; he refused to pay a tax to the state; he ate no flesh; he drank no wine; he never knew the use of tobacco; and, though a naturalist, he used neither trap nor gun."

Thoreau's works are: 'A Week on the Concord and Merrimac Rivers' (1849); 'Walden, or, Life in the Woods' (1854); 'Excursions' (1863); 'The Maine Woods' (1864); 'Cape Cod' (1865); 'Letters' (1865); 'A Yankee in Canada' (1866); 'Early Spring in Massachusetts' (1881); 'Summer' (1884); 'Winter' (1887); 'Autumn' (1892); 'Miscellanies' (1893); 'Journals' edited by Bradford Jorrey (1906).

THORVALDSEN, BERTEL (1770–1844). Copenhagen is bright with waving flags, and gay crowds in holiday attire throng the streets. A royal frigate comes to its dock amid such cheering as Denmark's capital has seldom heard. A returning hero is led to a royal carriage; the joyous people loose the horses from the shafts, and fight to haul the carriage in splendid triumph. In it sits Bertel Thorvaldsen, greatest of Danish sculptors and one of the greatest sculptors of modern times. He is returning to his native city after an absence of many years, and Copenhagen is merely echoing all Europe's glowing praises of his fame.

This glorious reception occurred one bright September day in 1838. It contrasted strangely with the hero's drab childhood. His parents had been so poor, the boy Bertel hardly had time to learn to read and write. The artist's father, Gotskalk Thorvaldsen, who had been a rather unskilled carver of figure-heads for ships, was the son of an Icelandic clergyman; his mother was a Jutland peasant.

Bertel was born Nov. 19, 1770, probably in Copenhagen. He entered his first sketching class when 11 years old. In 1793 he won the Great Gold Medal, and with it a stipend to cover three years of study in Rome. But his circumstances were so poor he did not get to Rome until four years later. Meantime, in

Copenhagen, Thorvaldsen mingled with artists who were as poor as himself. Always a lover of dogs, he had a poodle, "Mons. Primong," which was famous because it learned to bite the legs of creditors who came to worry its master.

In Rome Thorvaldsen was inspired to revive the classic sculpture of ancient Greece, and there he was often ill and often discouraged. His fame began in 1803, with his colossal statue 'Jason and the Golden Fleece'. In 1804 he was appointed a professor at the Academy of Florence. He was elected to the *Academie di San Luca* of Rome in 1808, and became president of this famous group in 1825.

Among Thorvaldsen's best-known works are 'Briseis', 'Cupid and Psyche', 'Morning', 'Night', 'Christus Consolator', and his portrait statue of Byron. His famous 'Lion of Lucerne', carved in natural rock to commemorate the heroic defense of the Tuileries by the Swiss Guards, was executed from Thorvaldsen's model. Some of his finest works are in private collections.

Thorvaldsen was called to Copenhagen by his king in 1819 to arrange for statues of Christ and the 12 apostles for a new church. He returned to Rome to complete the task, and his great triumph at Copenhagen came when he returned there 19 years later. He disliked statues set in niches; he held that only the front of such works required care and so with that in mind he made the church statues far too large for the niches.

Thorvaldsen's will left all his works, as originals or replicas, to the city of Copenhagen, and provided a fund to build a museum to house them. The Thorvaldsen Museum is one of his city's proudest possessions. The sculptor died while at the theater on March 24, 1844. His remains rest in a vault in the museum.

THORVALDSEN'S MEMORIAL TO SWISS VALOR

Thorvaldsen's 'Lion of Lucerne', in Glacier Garden, Lucerne, commemorates the Swiss Guards who, on Aug. 10, 1792, died in defense of the Tuileries in Paris, where Louis XVI and the royal family had sought refuge. It bears the Latin inscription, "To the loyalty and courage of the Swiss."

THRACE. The Balkan Peninsula thrusts out to the east a wedge of land that almost touches Asia. The shores of this land are washed in the north by the Black Sea and in the south by the Sea of Marmara and the Aegean Sea. At its easternmost tip stands the port of Istanbul, commanding the narrow funnel of the Bosporus. This small region is today divided among several nations; but it is still generally known by its ancient name of Thrace. (For map, *see* Balkan Peninsula.)

Thrace is a poor country, mountain-ribbed, with only a few wide plains in its river basins. The people are shepherds and farmers, who produce horses, grains, and wine. To the outside world, Thrace is important solely because of its strategic position. Many nations have vital interests here because Thrace not only controls the outlet from the Black Sea to the Mediterranean but provides a land bridge from Europe to the Near East.

The ancient Greeks colonized the northern coasts of the Aegean and gave the name Thrace to a vague region extending indefinitely northward. To them it was a cold, inhospitable land, the birthplace of Mars and the traditional home of the north wind Boreas. When Thrace became a province of the Roman Empire its northern limit was then fixed at the Balkan Mountains, and this remains the boundary today. Since Roman times the fortunes of Thrace have been closely connected with its great city Constantinople (now Istanbul), which was the capital of the Byzantine Empire. Constantinople fell to the Turks in 1453 and for centuries the Balkan Peninsula was under Turkish rule (*see* Istanbul; Balkan Peninsula).

Since the breakup of the Turkish Empire, boundary troubles have plagued the people of Thrace. The larger part is still in Turkish hands. Turkish, or Eastern, Thrace, "the backyard of Constantinople," reaches north to the Rhodope Mountains and south to the Aegean Sea. Western Thrace, a strip along the Aegean, forms the northeastern corner of Greece. Northern Thrace, from the Rhodope Mountains to the Balkan Mountains, belongs to Bulgaria, and is known as Eastern Rumelia. Bulgaria desires to regain the outlet across Thrace to the Aegean Sea, which it lost to Greece as a result of the first World War. Russia is vitally concerned with the region that commands the entrance to the Black Sea.

THRASHER. The flute, the violin, and the clarinet are all suggested in the beautiful notes poured forth by the brown thrasher, one of our most delightful songbirds. Sitting on a conspicuous perch at the top of a tree or bush, he gives a concert for all the world within hearing. His music rivals that of the mockingbird.

The thrasher is a furious warrior and will attack any intruder who threatens his nest or his young. When he is angry, or sometimes when he is excited by his song, he will "thrash" up and down with his long tail as if he were flailing grain.

There are several species of thrashers. With the mockingbird and the catbird they make up the group of "mimic thrushes," found only in America. The brown thrasher (*Toxostoma rufum*), which is found in

THE BRIGHT-EYED BROWN THRASHER

The brown thrasher, like its close relative, the mockingbird, is one of our finest singers. It is a large brown bird, with long tail, long, heavy bill, and white breast spotted with brown.

the eastern United States, ranges north to Canada and west to the Rockies. It is about 11 inches long, with a bright brown coat and a creamy white breast spotted with brown. The long bill curves downward at the tip. The short wings and long tail are rounded. The nest is built of sticks, leaves, and weed stems and is lined with plant fibers and rootlets. It is placed in bushes and low thorny trees. The eggs number three to five (for picture in color, *see* Egg). The brown thrasher is the state bird of Georgia. Common in the southwestern United States are the Palmer's (*T. curvirostre*), the California (*T. redivivum*), and the sage thrashers (*Oreoscoptes montanus*). They are clay colored but otherwise resemble the brown thrasher. (For picture in color of the Palmer's thrasher, *see* Birds.)

THREAD. You would be surprised if you looked about and counted the many uses for thread. On your person, you will find it in hats, clothing, and shoes. In the home, thread is in the living room rug, teabags in the kitchen, and the soft ball in the playroom. In the sewing basket is thread for embroidery, knitting, darning, crocheting, and machine sewing.

Thread dates from the beginning of civilization. Primitive women spun short plant or animal fibers into a continuous filament by twisting and drawing them out. They made cloth by weaving this yarn and wove it by draping or tying it. Later they learned to sew with thread made by twisting two or more yarns together. (*See also* Spinning and Weaving.)

Before the 1700's most thread was made from flax. After cotton textile machinery was invented, mills were established in Paisley, Scotland, to manufacture cotton thread. The first thread mill in the United States was set up about 1865 in Newark, N. J., by a Scottish threadmaker after England levied high tariffs on cotton from America. Many thread mills sprang up, primarily in New England.

Today the most commonly used natural fibers for threadmaking are cotton, silk, flax, and wool. Many synthetic fibers are also used. These include nylon, rayon, Orlon, Dacron, and others. Each has characteristics suitable for special purposes.

The manufacture of cotton thread involves a number of machine processes. Cotton from different bales is torn apart, mixed together, and cleaned. The fibers are laid parallel and straightened by carding and combing (*see* Fabrics). The thick rope that is formed is drawn out into a fine strand. This strand is spun into a thin single yarn by twisting. Two or more yarns are twisted together to form threads. Thread is made in a variety of sizes for many uses.

In the finishing department, the thread is mercerized by submerging it in caustic soda. This gives it a luster and makes it stronger and more receptive to dyes. It is bleached, or whitened, by exposing it to sunlight or chemicals. The thread is dyed by chemical processes and glazed by applying surface finishes.

Thread is wound, labeled, and packed for shipment as balls, cones, tubes, skeins, or spools. Machines wind it to exact yardage on wooden spools and fasten it in a cut on the spool's edge.

THRESHING. After a farmer has cut and gathered his crop of grains, he must *thresh* it to separate the seeds from the hulls and stalks. Until about 150 years ago, all farmers used the primitive threshing methods in use before Biblical times. They would loosen the kernels from the heads by beating the grain with a *flail* or would *tread out* the grain with oxen, horses, sleds, or wheels. A flail is a long-handled stick hinged with a thong to a shorter stick. Then they would separate the straw from the loosened kernels by raking. Finally they cleaned the grain by winnowing it. This they did by throwing the kernels into the air so that the wind would blow away the chaff, or sometimes they used a sheet to fan the chaff.

The first successful threshing machine was patented by Andrew Meikle of Scotland in 1788. Early in the 1800's stationary threshers were used in the United States. They were powered by walking horses or by men. An American patent in 1837 combined a thresher and a fanning mill and became the basis for later machines. These were first run by horsepower and later by steam engines and tractors.

The threshing machines cost too much for most individual farmers. During the harvesting season those who did own such machines went from farm to farm to thresh with hired crews. Or the threshing crew might be farmers in the area who worked on each other's farms as a co-operative group.

The next advance was the combine. It cut and gathered the grain and also threshed, separated, and cleaned it. It was developed in 1836 and put into commercial use in 1880. High grain prices and a labor shortage during World War I stimulated its use.

In operation, a reel of the combine holds the standing grain against a cutter bar. If the crop has been cut, an attachment permits pickup of the plants. Various kinds of conveyers carry the grain to a cylinder, which revolves over a stationary surface called the concaves. The cylinder, by beating with

toothed or rubber-edged bars or by rubbing with corrugated rasp bars, knocks the seed loose from the straw. As the straw travels over a vibrating straw rack, the kernels sift out. The straw is either chopped and spread over the field or dropped in windrows. A fan blows the chaff and dirt from the grain. The cleaned grain goes to a grain tank or is bagged.

An important improvement in 1935 was the one-man combine. Now the combine has almost completely replaced the threshing machine. Most combines are of the smaller size, cutting a swath between 40 inches and six feet. They may be pulled by a tractor or may be self-propelled. They are adjustable for a wide variety of crops, including cereal grains, grass and legume seeds, beans, peas, sorghums, rice, soybeans, and flax.

THRIFT. The practice of thrift means the wise management of all of one's income. It means not only earning money and saving it, but also careful spending, investing, and giving.

Thrift can begin with the very first money one earns or gets from an allowance. When first given an allowance, a young person is sometimes tempted to spend it all at once. Studies have been made, however, proving that boys and girls with allowances spend less money than those whose parents give them money whenever an apparent need for it arises.

From Budget to Savings Bank

The first step in the wise management of money income is the making of a budget. A budget is a careful plan for the use of money. In order to use a budget one must keep a personal expense account. This is simply a list of all the things for which one spends his money. For a young person it might include haircuts, school lunches, candy bars, tickets to athletic contests, books, stamps and stationery, savings for family presents, and permanent savings.

These items can then be grouped under such general headings as Transportation, Recreation, Food, School Supplies, Savings, and Miscellaneous. To pay for the items under each heading, one must figure what his income is going to be from an allowance, earnings from part-time jobs, and money from gifts. Then this income is divided, the necessary amount being allotted to each item on the list.

Revising the Budget

It is often necessary to change one's budget as income changes or new needs arise. A budget works best after it has been kept long enough to have good information about income and expenses. Keeping it can be an interesting and active experiment.

Once one has a budget that works over a period of time, savings can usually be made. These savings can then be deposited in a savings bank or savings association where they will earn interest. The rate of interest on deposits varies with different banks and savings associations (*see* Banks and Banking).

A banking service called "Postal Savings" is run by the United States government. Money deposited in postal savings departments of post offices earns 2 per cent interest. Savings accounts in a bank or in a

A BANK FOR JUNIOR SAVERS

Thrift is made attractive to junior savers at this unique "Children's Savings Corner" in a Chicago bank. Here young people learn early that saving dollars makes good sense.

postal savings account can be opened with as little as one dollar (*see* Post Office).

Other Investments

An easy method of investing money to earn interest is found in United States savings bonds. Savings bonds and other government bonds pay from 2 to 3 per cent interest, depending upon the type of bond (*see* Stocks and Bonds).

A form of saving which combines investment with family protection is insurance, which is sometimes called "America's thrift program." The various kinds of insurance are explained in the Insurance article.

School Savings Accounts

In many schools the saving and banking of money is carried on as a school-wide project. One morning each week student tellers conduct a regular banking business as part of their arithmetic program. The teller handles money, gives receipts, makes records, totals deposits, and prepares reports for the local bank. Signs are posted in all classrooms to remind students of Bank Day. Boys and girls on the Banking Committee conduct regular campaigns to have children start savings accounts. Sometimes a feature of the school assembly program is the awarding of a Thrift banner to the class with the best record of savings depositors. A Thrift chart is kept during the week honoring the class with the best record.

Much of the money deposited in school savings accounts is earned by young people who have jobs. They

earn money by clearing the school lunchroom tables, baby sitting, carrying newspapers, mowing lawns, selling magazines, and similar activities. The movement for school savings was started in California in 1911 by A. P. Giannini, founder of the Bank of America. School savings accounts are regular savings accounts in miniature. Deposits as low as one cent are accepted. They are entered in a regular pass book. Interest is paid on all balances. Today there are 192,000 school savings accounts in California, and the system is in operation generally all over America.

Wise Spending and Giving

Before spending money for goods the wise buyer compares quality and prices in various stores, studies advertisements, and questions "bargains." In the matter of charity he makes certain that the organization to which he is giving is well managed and doing worth-while work.

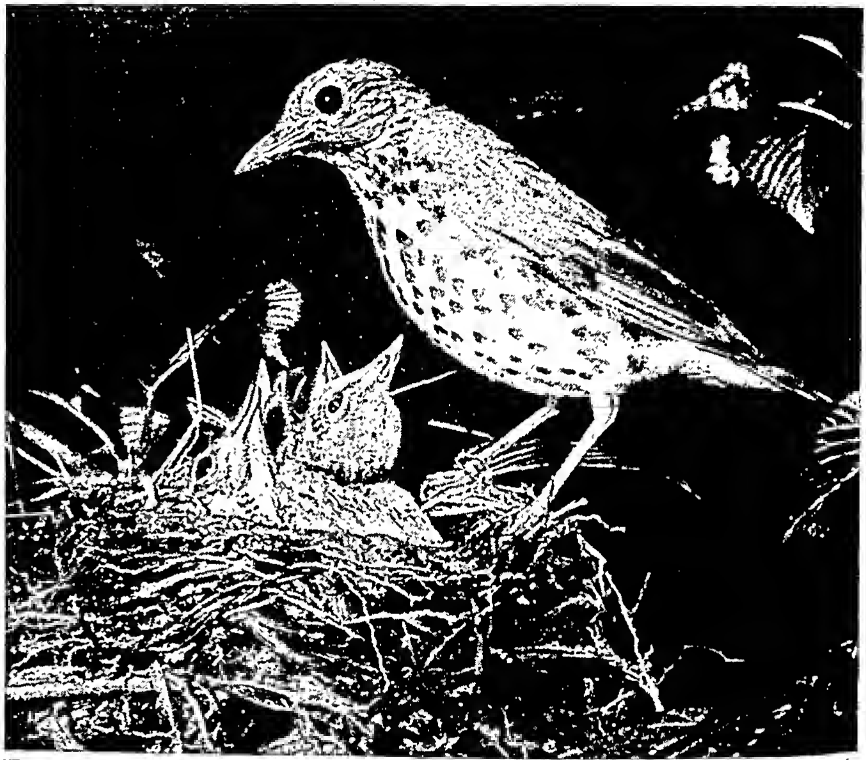
The wise buyer considers *credit buying* carefully before he uses it. The *charge account* is one method of buying with delayed payment. Goods are purchased and charged to one's account. Once a month the purchaser is billed for the things he has bought. *Installment buying* is another system of credit. The buyer pays a small amount as a down payment on his purchase. The remainder, usually plus an interest charge, is paid in equal sums over a period of months or years. Charge accounts are a convenience. Installment buying enables one to enjoy something now which he might otherwise have to wait a long time to obtain. Homes and automobiles are an example. Few people are able to pay cash for their homes or cars, and this is true of many other large purchases (*see* Installment Buying).

Household Thrift

A budget can also play a key role in household or family finance. "Fixed" expenses, such as shelter, clothing, food, household operating expenses, savings, and medical expenses, should be considered first. A fair average shelter allowance is from 10 to 20 per cent of the income, with the larger percentage for smaller incomes. If this percentage runs over 20 per cent, other needs are apt to be neglected. The clothing allotment may vary from 10 to 20 per cent also, but 15 per cent is the usual figure. Studies made by social workers indicate that the smaller the income, the greater the proportion which must be spent for food.

It is estimated that household expenses will take about 15 per cent of the annual income for a family at the moderate income level. Low incomes can allow about 10 per cent for recreation, and an increase to 25 per cent can be made for more liberal incomes. Moderate level incomes should allow 10 per cent for savings, and liberal incomes should increase this percentage several times.

THE WOOD THRUSH, SINGER OF GOLDEN NOTES



Here a wood thrush is attending its hungry young. This bird is seven or eight inches long, the largest of the thrushes except the robin. Its back is brown, ranging from bright cinnamon at the head to light olive brown at the tail; the underside is white with black spots.

THRUSH. The large thrush family boasts some of the finest singers in birdland. Among its famous members are the robin, the bluebird, and the nightingale, as well as those commonly known as thrushes. Though most of them are feathered in browns and buffs, others, such as the robin and bluebird, wear bright-hued plumage (for picture in color, *see* Birds). Whatever the color of the parent birds, all young thrushes, until their first autumn molt, have spotted breasts. Some species nest and live in trees, others on the ground; some feed on insects, others on fruits.

In England the song thrush, or mavis, the missel thrush, and the nightingale are the best-known species. The song of the mavis is so musical as to be frequently mistaken for that of the nightingale.

In the United States the wood thrush, the hermit thrush, and the veery are among the best known of the family. These are slender brown birds, seven to eight inches long. The veery has the least spotting on the breast. The hermit thrush may be distinguished by its

rufous tail, contrasting with olive back. The wood thrush is the largest and has a cinnamon-brown head. All three are wonderful singers.

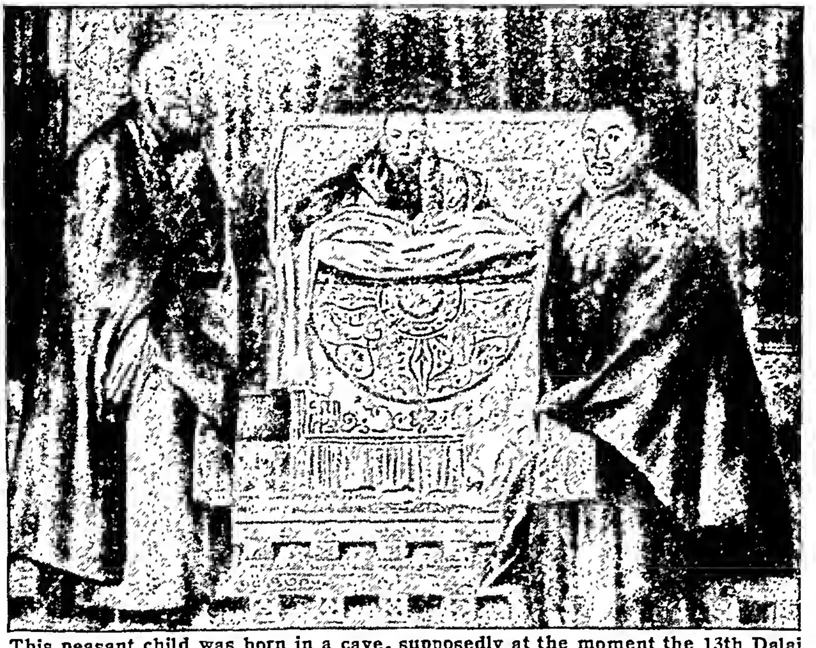
The wood thrush often nests in wooded city lots. The hermit prefers secluded northern forests. The veery's home is in low, wet woodlands with dense underbrush. They lay three or four greenish-blue eggs. The wood thrush is the official bird of the District of Columbia; the hermit thrush is the state bird of Vermont. The willow thrush is a western subspecies of the veery. (*See also* Bluebird; Nightingale; Robin.)

The scientific name of the thrush family is *Turdidae*; of the wood thrush, *Hylocichla mustelina;* of the hermit thrush, *Hylocichla guttata;* of the veery and willow thrush, *Hylocichla fuscescens.*

TIBER RIVER. The swift-flowing stream on which ancient Rome was built is laden with historic memories and associations. Many are the triumphs the river witnessed in the days of imperial Rome's greatness, many are the dark deeds done on its banks, and many times have its yellow waters run red with blood. The Romans fondly called it "Father Tiber"; for they loved the stream which watered their land, joined the city with the sea, and helped to protect them from invasion. Yet sometimes the river god appeared to be angry, for the swelling waters rushed over the land in disastrous floods; as indeed they have done even in recent times, though massive embankments have lessened this danger.

Beginning as a little bubbling mountain brook on the western slopes of the Apennines, the Tiber is joined by other small streams as it flows southward and westward to the Mediterranean. As it gains in force and volume, it gathers great quantities of tawny clay, which gives it its famous yellow color. So much sediment has been deposited at its mouth that Ostia, the ancient port of Rome, is now more than four miles inland. The Tiber is the most important stream of Italy south of the valley of the Po. Along its winding course of 245 miles are many cities, chief of which is Perugia, which like Rome is filled with interesting remains of ancient days. The Tiber is navigable for small steamers to Rome, 17 miles from its mouth, and for lighter boats for about 60 miles farther up.

THE 14TH DALAI LAMA INSTALLED ON HIS THRONE



This peasant child was born in a cave, supposedly at the moment the 13th Dalai Lama died in 1933. Tibetans believe him to be the reincarnation of the dead ruler. Usually a Dalai Lama must wait till he is 18 for the title "owner of all living things in the snowy country," but this one became ruler in 1950.

TIBET′. The highest country in the world is Tibet. It lies in central Asia, among the tallest mountains on earth. Many peaks rise more than five miles above sea level. Even the flatter lands between the mountain ranges may lie three miles above the sea.

The people of this high land are almost shut off from the world. The snow-clad Himalaya Mountains cut off India at the south. Among them stands Mount Everest, the world's loftiest mountain. The Pamirs rise in the west, and the Kunlun Range to the north. To the east lies the wild mountain land of western China. (For map, *see* China.) The country has no railroads, and only a few carts. Shaggy yaks carry the loads.

Northern Tibet is a cold, windswept desert. Most of the people live in the south. There the summers are fairly warm, and the rainfall is from 10 to 20 inches a year. The rain and melted mountain snow feed two of India's great rivers. The Indus flows to the west into the Arabian Sea. The Brahmaputra flows to the east through a deep, fertile valley in the Himalayas. A caravan trail winds over the mountains to the capital city, Lhasa. The Chinese Road or "Tea Road," also ends there.

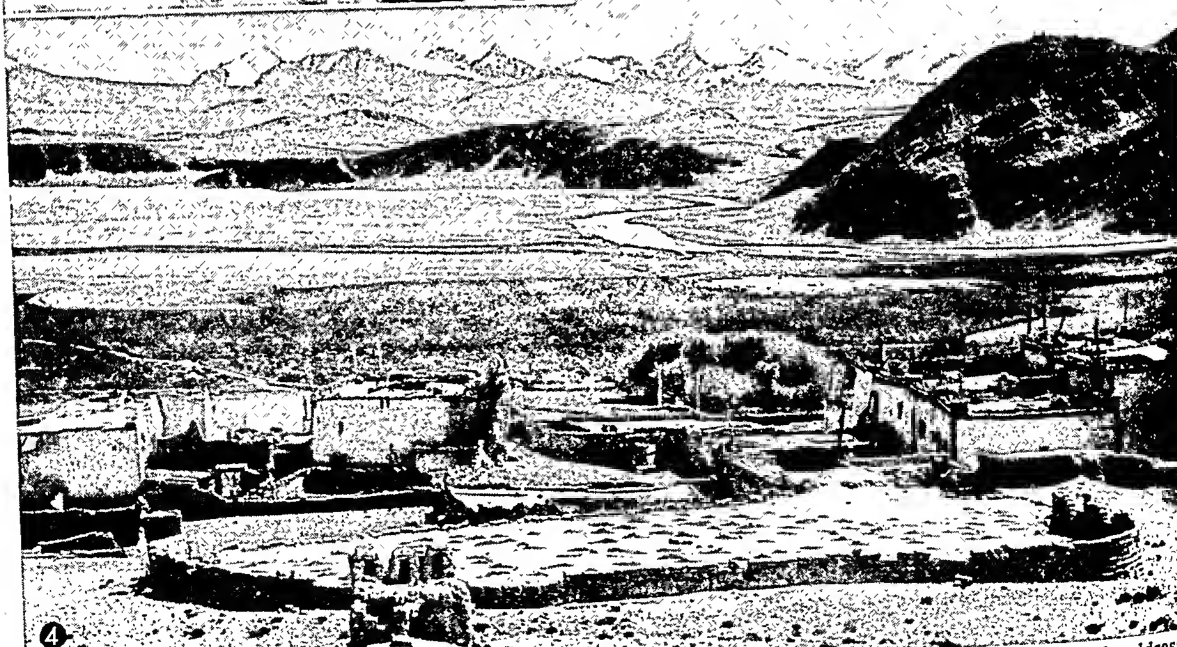
Western Tibet gets most of its moisture as snow, and may have frost at night even in August. The south and east have a growing season from April to September.

The Tibetans are hardy, brown-skinned Mongolians, rather short in stature. In winter they wear knee-length felt boots and a long sheepskin robe. They hold the robe tightly at the waist with a belt. This makes a blouse for holding articles. Wealthy women wear enormous wooden headdresses ornamented with jewels. Officials wear a long earring dangling from the left ear.

In the 7th century the Buddhist religion came to Tibet (*see* Buddha). The Tibetans blended it with their ancient magic rites into a faith called Lamaism. This religion like Buddhism teaches reincarnation—that the soul returns to earth again and again. Sinners may return as insects or animals, but holy men progress toward Nirvana (heaven). Tibetans therefore give a lot of time to religious observances.

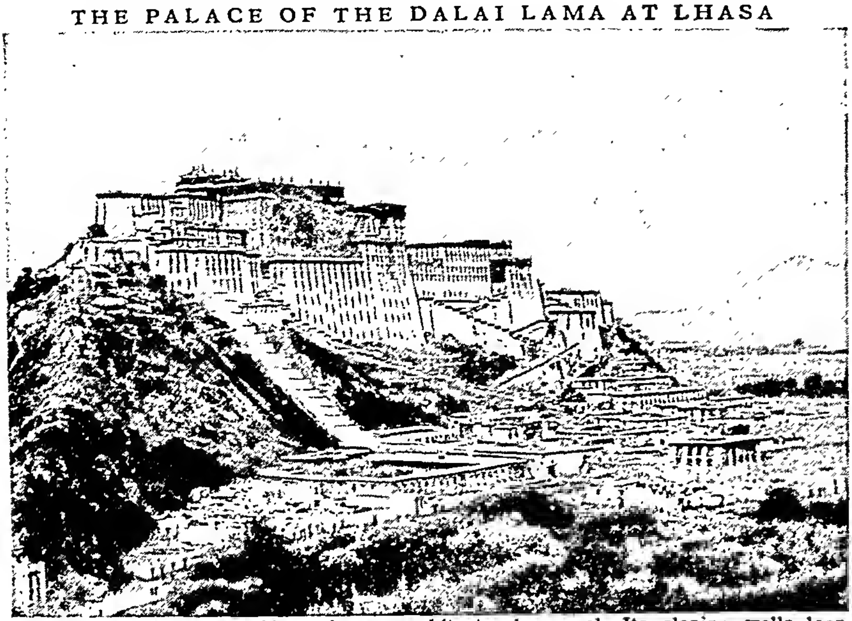
Almost one-fifth of the boys become lamas (monks). Great lamasaries (monasteries) dot the countryside.

STRANGE COSTUMES AND CUSTOMS IN FARAWAY TIBET



1. A wealthy Tibetan woman, center, is attended by her two servants. The mistress and her maid wear wooden headdresses ornamented with beads. 2. Tibetan lamas (priests) and their young pupils don masks and symbolic garb for a devil dance. 3. These men are professional prayers. They hold "prayer wheels" laden with charms. Tibetans believe a good harvest is insured when they twirl them in the fields. 4. This herdsman's village lies almost three miles above sea level. Notice the glacial stream in the center, the snow-capped mountains, and the stone corral for yaks in the foreground.

THE PALACE OF THE DALAI LAMA AT LHASA



The Potala (palace) in Lhasa is an architectural marvel. Its sloping walls lean against the hill and rise 15 stories high. The walls are red and white, the roof gold. The Dalai Lama lives in the high central part.

Some house as many as a thousand lamas. The people make long pilgrimages to holy temples, and sometimes prostrate themselves every yard along the way. But praying is made easy by "prayer wheels." These are hollow cylinders stuffed with printed prayers and mounted on a stick. A Tibetan can say his prayers by simply twirling the wheel.

The Dalai Lama and Panchen Lama

Tibet's government is rooted in religion. The spiritual head was long the Panchen Lama; the temporal, the Dalai Lama. Tibetans believe both to be reincarnations of priest-kings. Priests use magic rites to find the child Lamas. Then the children must "prove" they are reincarnations by picking up religious objects used by their predecessors. But in 1923 supporters of the Dalai Lama forced the Panchen Lama into exile in China. The Dalai Lama became supreme.

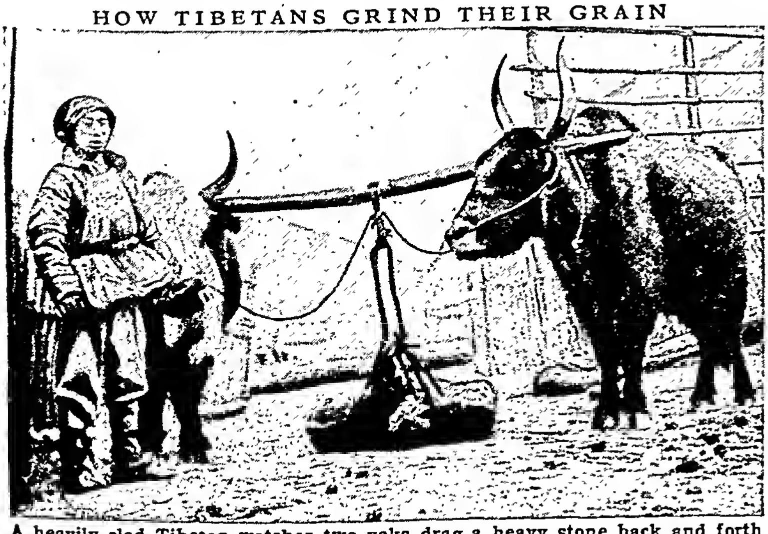
Wealthy nobles and lamas own all the land and control the herdsmen and farmers like feudal lords. The herdsmen live in tents made of yak hair. They pasture their sheep and goats in grassy valleys, and let their yaks roam the hills to find moss (*see* Yak). The farmers live in villages. Around their small mud or stone huts they build high outer walls to keep out the wind. They grow barley and peas, and, in some valleys, peaches and grapes.

Lamaism forbids killing any animal or even insect; but at times the Tibetans slaughter sheep. Their chief food is yak butter stewed with tea. They also pay taxes with yak butter and burn it in their lamps. For cooking fuel they burn yak dung, since wood is scarce. They do not heat their houses. Polyandry (which means that a woman may have several husbands) is common among the peasants.

Tibet is thought to be rich in gold, oil, and coal; but only gold, borax, and salt are mined. The peasants spin and weave wool. There are no factories. Traders carry wool, gold, and musk over the Chinese road and return with loads of cheap tea packed in bricks. From India they get cotton goods.

For hundreds of years foreigners could not enter Lhasa, the "forbidden city." But in 1904 a British military expedition set up trade posts. After some 200 years of paying tribute to China, Tibet declared its independence in 1911. Chinese officials entered in 1932 but permitted civil and religious self-rule. In 1950 Communist China invaded Tibet. The boy Dalai Lama fled Lhasa. In 1951 China took military control. China acknowledged the Dalai Lama as temporal head but also recognized the Panchen Lama then exiled in China. Population variously estimated at from 1,000,000 to 3,000,000; area about 463,000 square miles.

HOW TIBETANS GRIND THEIR GRAIN

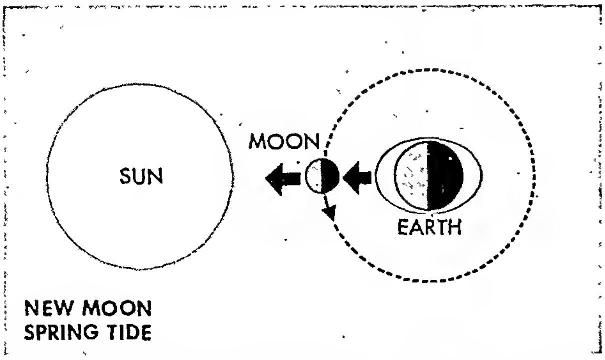


A heavily clad Tibetan watches two yaks drag a heavy stone back and forth across a threshing floor. The stone grinds grains of barley into coarse flour. The sturdy yak serves also as the beast of all purposes in Tibet.

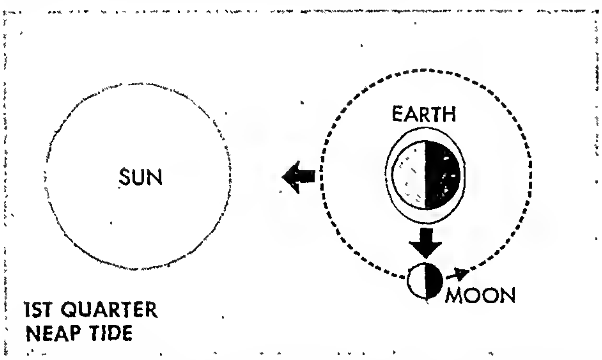
TIDE. On any ocean beach the water can be seen creeping up for about six hours, then falling back for another six hours. In ocean harbors ships may rise and fall ten feet at their wharves in the same time. This steady rising and falling action of ocean water is called the tide.

Tides were not completely understood until Sir Isaac Newton discovered the law of gravitation (*see* Newton). Now it is known that water is drawn up mainly by the pull of the moon. Since the sun is much larger than the moon it might be expected to cause strong tides by itself. However, because the moon is much closer to the earth it exerts more than twice the tide-making pull of the sun.

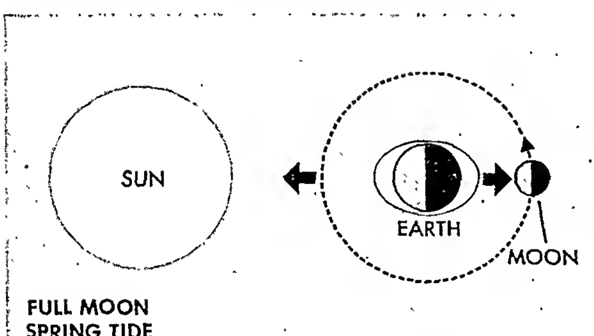
HOW THE MOON AND SUN CAUSE TIDES



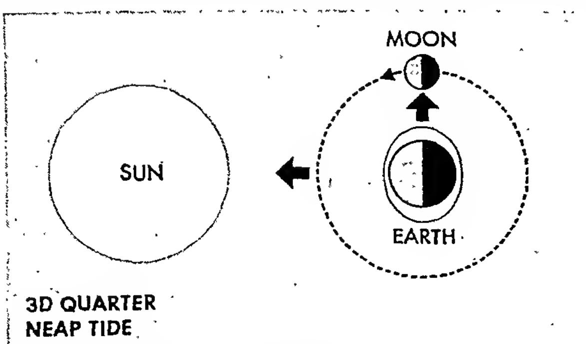
The moon and sun pulling together cause the strong spring tide. They pull the water away from the earth on the near side and pull the earth away from the water on the far side of the globe.



The moon and sun pulling at right angles to each other cause the lesser neap tide. The gravitational pull of the moon is partially canceled by the sun's angular gravitational pull.



Here the moon is pulling on one side of the earth and the sun on the side directly opposite. Together they draw the water up from the earth and the earth down from the water, causing a spring tide.



In the moon's third quarter, the action of the first quarter repeats to cause the scantier neap tide. There are two spring and two neap tides for each revolution of the moon around the earth.

When the moon pulls over an ocean area, it tends to heap up the water under it. Thus a great wave, or tide, starts traveling across the sea, gradually building up to high tide. Then the earth's rotation leaves the moon far behind and the water retreats to low tide. (*See also* Moon.)

Such a tide may be called a *direct* tide. There is also an *opposite* tide which occurs at the same time on the opposite side of the earth. During the same period when the moon lifts the water on the side nearest it, it pulls the earth away from the water on the opposite side. This causes another heaping up of water at that point.

Thus there are always two high tides opposite each other and two low tides at equal distances between them. They follow one another alternately, with an average time interval of about 6 hours, $12\frac{1}{2}$ minutes between the points of high and low tides. This makes the whole tide cycle take place every 24 hours, 50 minutes, or about 50 minutes later each day. In either rising or falling, tides begin slowly and reach their fastest flow about midway in time. Then they taper off until the final high or low point is reached.

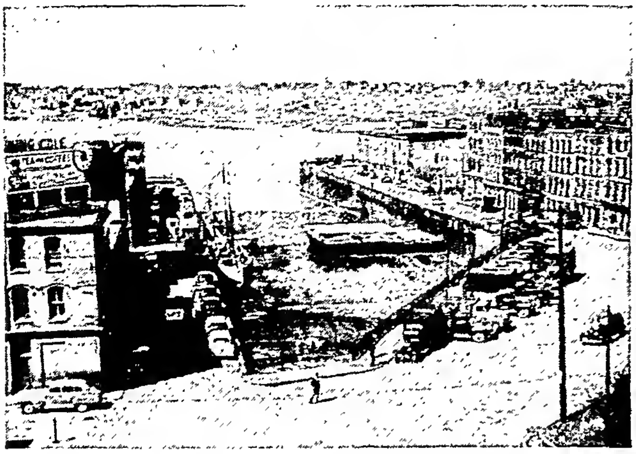
Twice in the course of every month, when the moon is either full or new, it comes into line with the sun. At these times both moon and sun attract the earth from the same direction. The higher and lower tides they cause are called *spring* tides (although they have nothing to do with the season). At the first and third quarters of the moon, the sun and moon are pulling at right angles to each other. This causes *neap*, meaning "nipped" or "scanty," tides. The high tide is not as high, nor the low tide as low.

The difference between high and low water is called the *range* of the tide. The rising and falling movement of the tide is termed the *tidal current*. When the water moves inland, or toward the coast, it is called the *flood current*. When it flows out to sea it is called the *ebb current*.

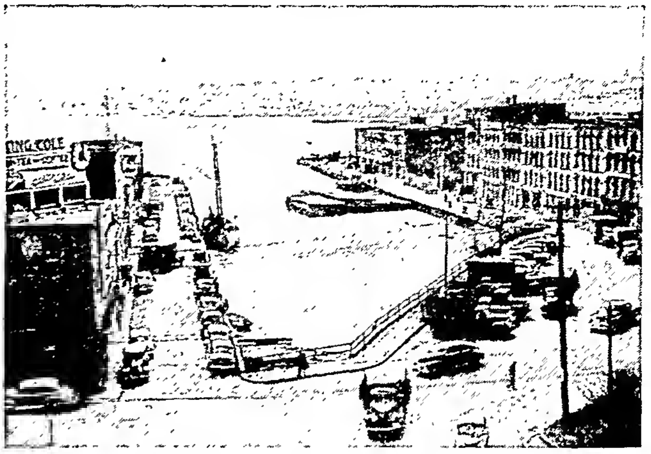
In the mouths of some rivers, and sometimes in sharply narrowing ocean inlets, the rising spring tide is often very spectacular in its rush and noise. The tide overcomes the current of the river, and a single high wave, moving forward like a wall of water, rushes with a roaring noise up the river bed. This phenomenon is called a *bore*, or an *eagre*. In one branch of the Ganges River the bore travels 70 miles in 4 hours and often appears suddenly as a wall 7 feet high. In the mouth of the Amazon the wall sometimes reaches a height of 15 feet.

The extent of the rise and fall of the tide varies greatly in different places. In midocean the difference between high and low water is about 2 or 3 feet. On the shores of continents, especially in gradually narrowing bays, the difference is very great. The average spring tide at New York City Harbor is about $5\frac{1}{2}$ feet, and in Boston about 11. At the Bay of Fundy, between New Brunswick and Nova Scotia, it can rise $53\frac{1}{2}$ feet from low water and even higher during exceptional storm conditions. A slight air tide follows the water tide.

EXTREME TIDES IN THE BAY OF FUNDY



Here is low tide at Market Slip, Saint John, New Brunswick, in the Bay of Fundy. Note that the clock reads 10:20 A.M. On the virtually dry bottom the ship is resting on a pile of "mattresses."



At 4:00 P.M. the high point of high tide is nearly reached. The ship is well afloat, as are the rafts to the right. The extreme difference between high and low tides is as much as 53½ feet.

Lake tides are too small to be noticeable. Lake Michigan and Lake Superior tides are less than two inches. In landlocked seas, such as the Mediterranean, the tides are also slight.

Making Use of Tide Knowledge

A knowledge of tides is very important to the ship navigator. A question of a foot or two in depth on a dangerous shoal may involve human life and property aboard the ship. Thus the United States and other governments furnish tables showing the fluctuations at all important ports for every hour of every day for as much as a year ahead. These are calculated by complex machines called *tide predictors*. Automatic *tide gauges* measure the actual rise and fall of tides.

For years men have puzzled over the problem of how to capture and use the tremendous energy created when the moon and sun alternately lift and drop these billions of tons of water twice daily. If this energy could be harnessed, it would provide all the electric power needed by industry and transportation.

One such experimental power plant has already been started on the Bay of Biscay in France. Passamaquoddy Bay, between the state of Maine and the Canadian province of New Brunswick, is under consideration by the federal government as a possible American site for a similar experiment.

TIENTSIN (*tĭn'tsĭn'*), **CHINA.** Few shipping centers have so poor a natural harbor as Tientsin, yet this city 40 miles inland on the Pei River is a world port —for it is the gateway to the vast agricultural plain of northern China. Only small craft can enter the shallow, silted harbor. Large vessels must unload at Tangku on the Gulf of Chihli or stand out to sea before Taku Bar. Cargoes are freighted, or lightered, up the twisting Pei Ho. In winter the river must be opened by icebreakers, or cargoes must be brought in from the ice-free port of Chinwangtao to the northeast.

Once in Tientsin, it is easy to see why shippers take all this trouble, for Tientsin is the hub of a network of routes to the productive interior. The navigable Pei Ho connects Tientsin with Peiping, about 80 miles northwest; the Grand Canal links it with Hangchow and the Yangtze. Spreading from the city are railroads, highways, and caravan routes. From the numerous farms, villages, and grazing grounds of the fertile plain come cotton, hides, bristles, furs, peanuts, and especially wheat and wool.

As the trade center of Hopeh Province and northern China, Tientsin has been a prize of war. In 1860 it was seized by England and France and was opened to world trade by the Treaty of Tientsin. European nations and Japan established foreign concessions, and the city became one of the most modern in China. During the Boxer Rebellion of 1900, the foreign quarter was besieged for 27 days until it was relieved by United States Marines and the allied forces. Little more than a generation later, in 1937, Tientsin was seized by Japan and cut off from independent China. Population (1947 est.), 1,686,543.

TIGER. On the African continent the lion reigns supreme, sole monarch over its own feline race. In Asia its sovereignty is disputed by the most formidable member of the cat tribe. Majestic as the lion appears when viewed full face, with its great bushy mane, it lacks the agile strength of its near relative. The tiger is larger, stronger, quicker, more graceful, and has great cunning. It is also the most perfect and beautiful of its race, owing to the bright coloring of its coat, its litheness, and its proportions.

So fierce and wily is the tiger that it is usually hunted from elephants and with a large party of men. Only a veteran hunter of great skill and experience dares approach the tiger on foot. Its terrible perfection inspired the poem by William Blake beginning—

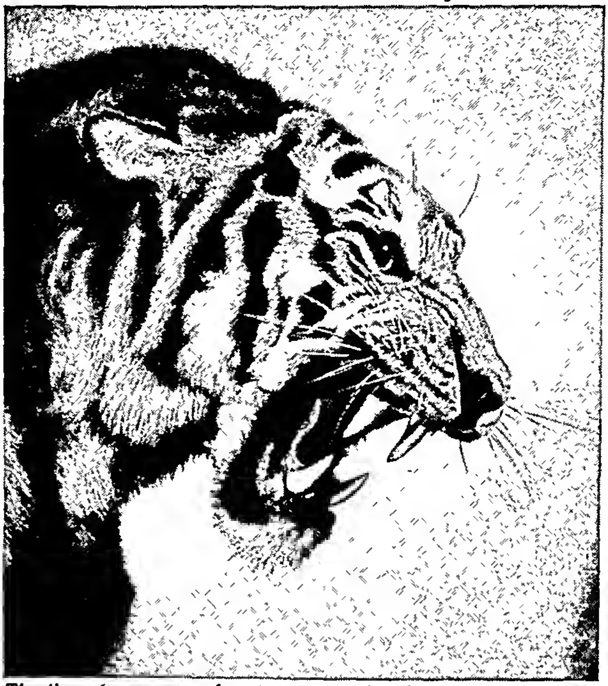
> Tiger, tiger, burning bright
> In the forests of the night,
> What immortal hand or eye
> Could frame thy fearful symmetry?

Asia is the home of the tiger. It is not found on any other continent. In Asia, however, tigers are found from Iran to the Sea of Okhotsk in eastern Siberia, and from this northeastern limit southward to Malaya and the Indian Peninsula. A smaller variety is found on the islands of Sumatra, Java, and Bali.

All tigers belong to the same species (*Felis tigris*). They differ only in size and the character and markings of the coat. In all of them, the ground color of the coat ranges from a light tinge of yellow on the belly to a deep yellow or orange on the back. The head, body, and limbs are striped with black, and the tail has black rings. This coloring blends well with dried grass or a thicket of reeds and makes the tiger almost invisible when stalking its prey.

Tigers differ from lions chiefly in the coloring of their coats and in not having manes. Their skeletons are almost exactly alike. Zoologists distinguish the tiger skull by the higher setting of the nasal bones. The two species are alike in hunting habits, except that tigers rarely hunt in pairs, as lions often do. Tigers and lions can interbreed.

FEARSOME TEETH AND JAWS



The lion alone among beasts can match this snarling Siberian tiger for gripping power of jaw muscles and long, canine teeth.

Hunting Habits of the Tiger

Tigers prefer damp, thickly overgrown localities, such as dense jungles and river banks covered with reeds or brush. In such localities they like to stalk their prey at night. If necessary, they will prowl about by daylight.

They prey upon many other wild animals. Wherever men have domestic animals, tigers destroy a large number of cattle, horses, sheep, and goats. A cattle-eating tiger will kill an ox about every five days, or from 60 to 70 a year. Unless it is cornered or greatly provoked the tiger avoids the elephant, and it rarely attacks a large buffalo or bear. In encounters with these animals the tiger is frequently worsted.

Unlike most members of the cat family, tigers are good swimmers. They cross rivers readily in search of prey. Occasionally, in order to escape floods or some other pressing danger, they will even climb trees.

Tigers do not naturally prey on man, but a few do become man-eaters when they lose the ability to kill their natural prey. Broken teeth, broken claws, or failing strength may cause an old tiger to become a

FITTED FOR LIFE IN THE FROZEN NORTH

Instead of roaming the hot jungles of the Indian peninsula, this Siberian tiger hunts in lands as cold as northern Canada. Its coat is correspondingly thick and warm, making it look somewhat less sleek than its Indian cousin.

THE MONARCH OF THE ASIATIC JUNGLE

No beast disputes the rule of the Royal Bengal tiger of the Indian peninsula. It is the fiercest of the cat family and the largest and most powerful of the great cats, surpassing the lion. The tiger haunts woods and dense thickets, where its black-striped tawny hide makes it almost invisible. By day it usually hides in the jungle, but at night it roams around in search of prey. Unlike the lions the tigers are solitary beasts, preferring to wander alone. Here is one of these master cats and its victim, an antelope.

man-eater. Even young tigers may turn to killing human beings if infected gunshot wounds or embedded porcupine quills incapacitate them. One case is recorded of a tiger killing 127 persons in a single year. An average of 1,000 people are killed by tigers every year, mostly in the Indian peninsula.

Tiger kittens number from two to five in a litter, but more than two are rarely raised. The gestation period is from 98 to 110 days. The young remain with their mother until their third year, while she teaches them how to stalk prey.

Varieties of Tigers

The best-known variety of tiger is found in the Indian peninsula. This is the Royal Bengal. A full-grown male will weigh as much as 500 pounds and may be ten feet long, including the three-foot tail.

The Siberian tiger is even larger. Males sometimes measure up to 13 feet long, including the tail. These tigers have a long, thick coat. The Bengal and Siberian varieties are the ones most commonly seen in zoos. Other varieties are those of Mongolia, China, Iran, Sumatra, Java, and Bali.

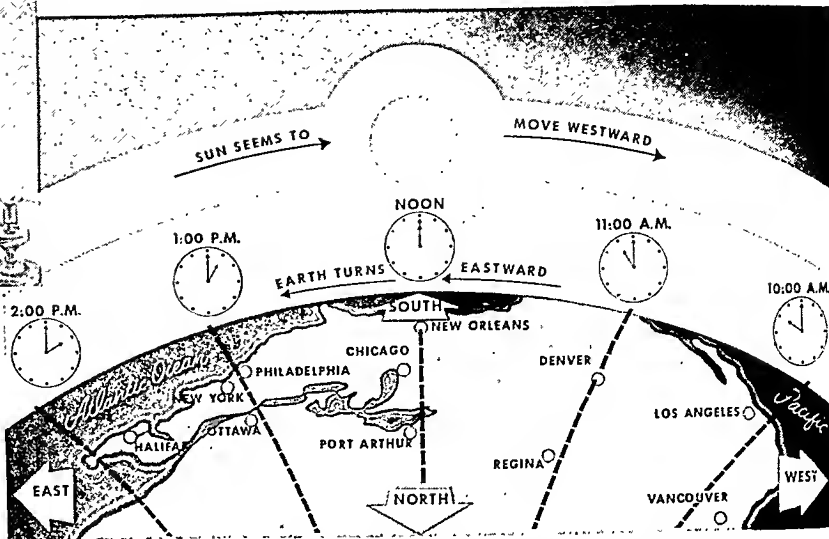
Tigers have been known since remote prehistoric times. During warm interglacial periods in the Ice Age, they roamed far to the north in Europe. Among the most fearsome types was the saber-toothed tiger, with a pair of upper teeth almost half as long as its skull (*see* Saber-toothed Tiger).

TIGRIS (*tī′ gris*) **RIVER.** The streams that join to form the Tigris River rise in high mountains that rim Lake Van, in eastern Turkey. Leaving Turkey, the Tigris touches the northeast border of Syria and then flows southeast across Iraq. In Iraq it is joined by tributaries from the east—principally the Great Zab, Little Zab, and Diyala. The Euphrates, west of the Tigris, runs in the same general direction. In ancient times the two rivers had separate mouths. Now they meet in a swamp in southern Iraq and form a single stream, the Shatt-el-Arab, which flows into the head of the Persian Gulf. The Tigris, 1,150 miles long, is shorter than the Euphrates, but it is more important commercially because its channel is deeper.

The fertile region between the Tigris and the Euphrates was called Mesopotamia by the ancient Greeks. Here flourished the earliest known civilization (*see* Babylonia and Assyria). The Tigris was the great river of Assyria. The ancient Assur, which gave its name to Assyria, stood on its banks, as did Nineveh, Assyria's splendid capital. Much later the Macedonian general Seleucus built his capital city Seleucia on the Tigris; and across the river from Seleucia the Parthian kings built Ctesiphon. The chief cities on the river today are Baghdad, the capital of Iraq (*see* Baghdad), and Mosul, farther upstream. River steamers make regular trips between Basra, a modern port on the Shatt-el-Arab, and Baghdad.

Since ancient times, the people of Mesopotamia have depended on the water of the two rivers to irrigate their hot, dry land. The soil itself is largely a gift of the rivers, which deposit tremendous quantities of silt on their lower course. The shallow Persian Gulf is being filled in at the rate of about 70 feet a year, and ruins of cities that were once gulf ports now lie far inland. (*See also* Iraq; Euphrates River.)

TIME *and* TIMEKEEPING



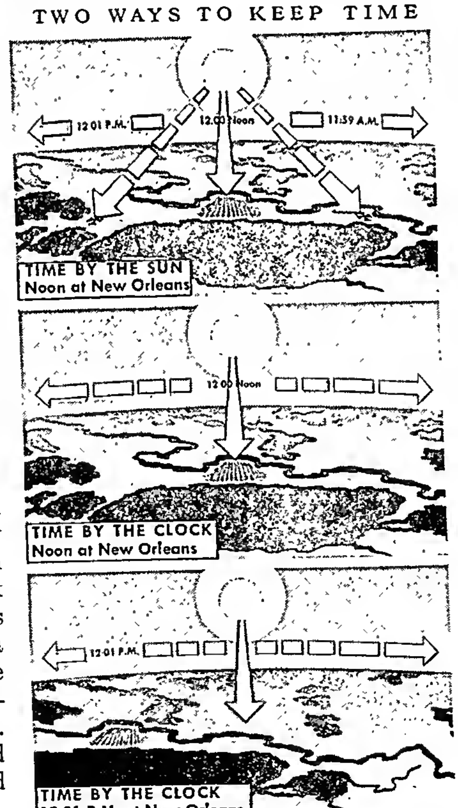
The boy above is using a globe and a lamp to see how time is told by the sun. The lamp represents the sun. He is looking *south* across Canada and the United States, and he has New Orleans in line with the sun. This position of the globe corresponds to noon in New Orleans. The clocks in the right-hand diagram show what time it is in other places at this same moment. To people in these places the sun is farther west or east and the time is accordingly earlier or later than noon.

TIME. Men have always measured time by something which moves at a steady pace. This might be the hands of a clock or the sun moving across the sky. The earth itself is our best means of measuring time. It turns on its axis at a perfectly steady speed day after day. This turning (rotation) makes the sun and the stars seem to move across the sky. (*See also* Day and Night.)

Men keep track of time by this *apparent* motion of the sun and stars. The hours of daylight begin when the sun rises in the east and end when it sets in the west. The daylight hours are halfway spent when the sun is high in the sky between these two positions. In the Northern Hemisphere the sun is then south of an observer.

From the earliest days, men have told time during the day by noticing where the sun stood in the sky. At night they kept track of time by the stars. When clocks were invented, they offered a simpler way to tell time. People then generally forgot about telling time from the sun and stars. But clocks must be regulated, and time must still be determined first from the sun or the stars.

TWO WAYS TO KEEP TIME



These diagrams show a closeup view of New Orleans. The sun is straight south at noon (top). If the people in near-by places kept time by the sun alone, it would be one minute later a few miles east of the city and one minute earlier a few miles west. This would cause trouble (center), so people keep New Orleans time throughout a broad *time zone.* At 12:01 P.M. in New Orleans (bottom) it is 12:01 P.M. everywhere in the zone. This system is called standard time.

Telling Time by the Sun

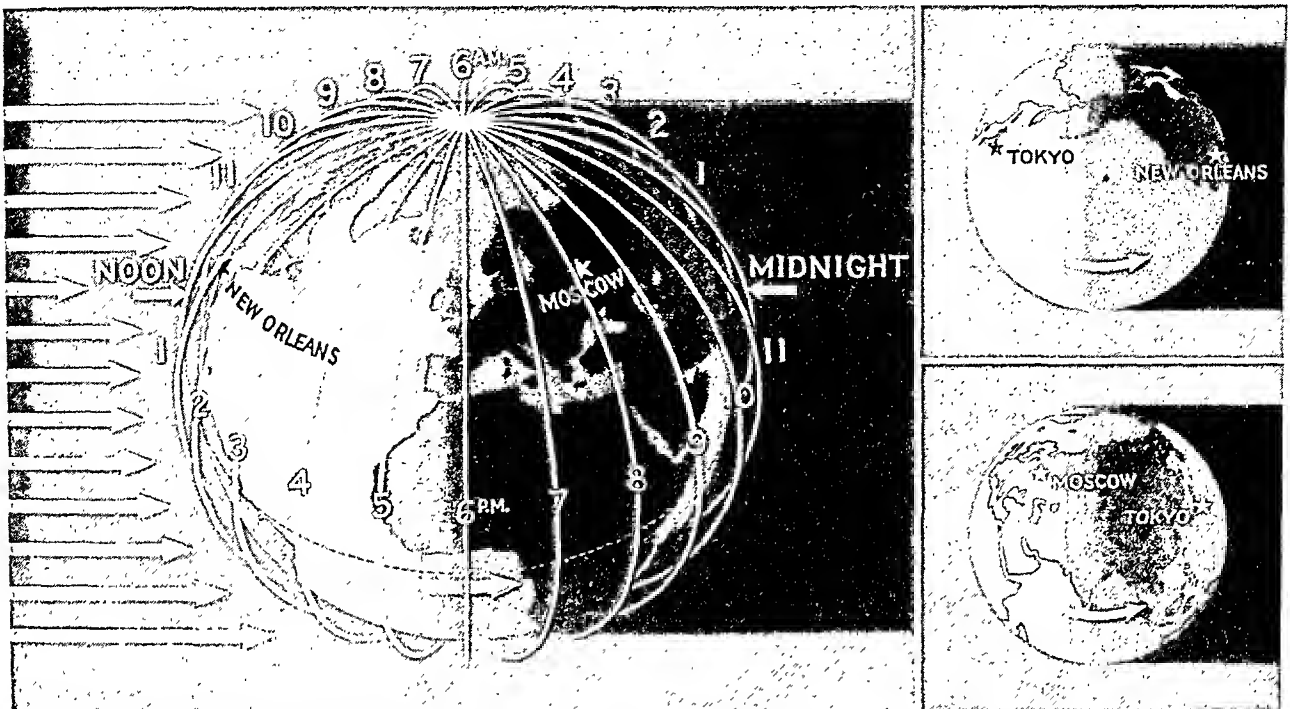
In timekeeping it is important to determine the exact moment of noon. Imagine a vast curved line in the sky, stretching from the north point of the horizon up overhead and down to the south point. Astronomers call this line the *meridian.* It corresponds to the observer's meridian of longitude (*see* Longitude). When the middle of the sun crosses an observer's meridian, it is noon for him. While the sun is still east of the meridian, it is morning. After the sun has crossed the meridian it is afternoon. The word meridian is from the Latin *meridies* which means "midday." The abbreviation A.M. is for *ante meridiem,* meaning "before midday," and P.M. is for *post meridiem,* meaning "after midday."

Thus it is easy to tell when it is noon by the sun. Other daylight hours can be told from the apparent motion of the sun from east to west. The sun seems to move completely around the earth, making a full circle, every 24 hours. As a full circle has 360 degrees, the sun moves through 1/24th of this, or 15 degrees, every hour. This span can be judged by holding a new pencil at arm's length. The angle from one end to the other of the pencil is about 15 degrees. The distance of the sun from the meridian, in degrees, thus shows the time before or after noon. At night, the stars can be used to tell time.

Apparent and Standard Time

When it is noon for the meridian of a locality such as New Orleans in the picture, it is also noon for every other place on the same meridian. The sun has not yet come to the meridian 15 degrees

HOW TIME CHANGES AS THE EARTH TURNS



Imagine the earth turning inside a "time cage" (left) fixed in space. In 24 hours every point passes under each of the time lines in turn. Here New Orleans is under the noon line. Eight hours later (top right) New Orleans is under the 8:00 P.M. line. In another eight hours (bottom right) New Orleans is under the 4:00 A.M. line, out of sight to us. Notice where the other cities are.

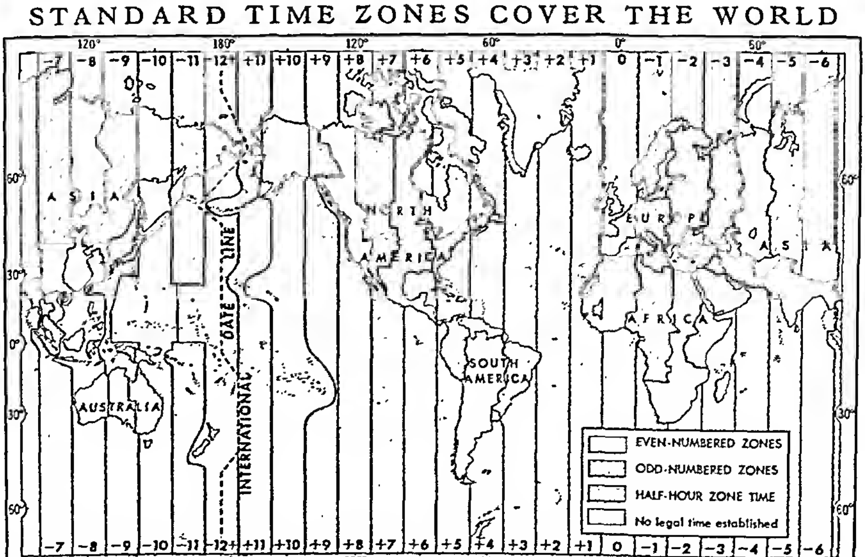
farther west, and the time there is 11:00 A.M. People on the meridian 15 degrees farther east have already had noon, and for them the time is 1:00 P.M.

Between these meridians, time by the sun differs by four minutes for each degree of longitude. At New Orleans, the difference amounts to one minute for about every 15 miles east or west. At the latitude of Ottawa, Canada, the corresponding distance is about 12 miles. Time kept in this way may be called "time by the sun" or "solar time." Astronomers call it *apparent solar time* and ship navigators term it *local apparent time.*

Apparent time might serve well enough if everybody stayed home. But it would be extremely awkward for travelers. They would have to set their watches whenever they traveled a few miles east or west. To avoid this nuisance, most civilized nations have adopted *standard time*. Under this system, everyone living in a broad *time zone* keeps the same time. These zones are about 15 degrees wide in longitude. In each one, the time is that of a central meridian of longitude which runs down the middle of the zone. Thus in any zone everyone observes noon at the same instant. Keeping apparent time, these same people would observe noon at different times depending on where they lived.

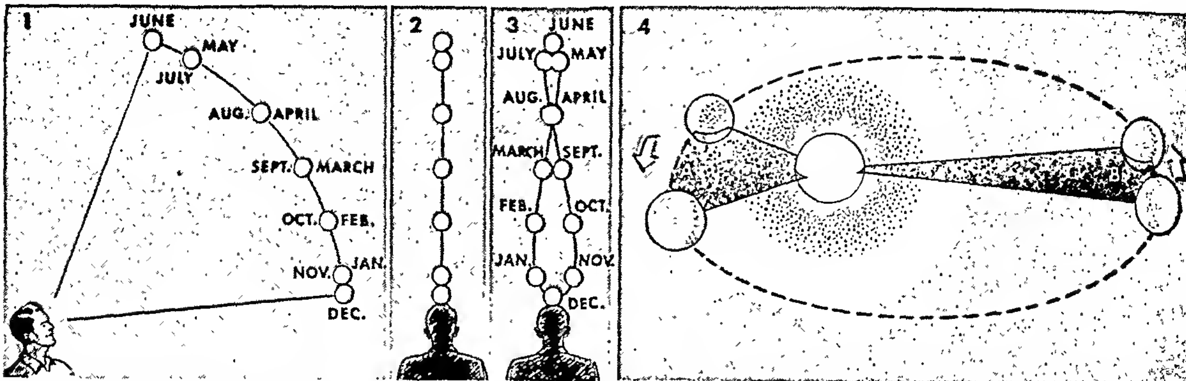
World-wide time zones start with the prime meridian, the meridian of Greenwich, England. There are 24 zones all together, and travelers need only change their time by one hour as they pass from zone to zone. On land, zone boundaries zigzag a good deal in order to follow national and state boundaries or natural features. The zone based on the 180th meridian is divided in two by the international date line. The two halves keep the same time but use different dates (*see* International Date Line).

STANDARD TIME ZONES COVER THE WORLD



This map shows time zones around the earth. Over oceans they are just 15 degrees wide, but on land they zigzag to suit local convenience. Each zone has a *zone description* number. It tells by how many hours the zone time differs from Greenwich time. Notice that in a few places the time differs from that of neighboring zones by a half-hour.

EVEN THE SUN IS NOT ALWAYS ON TIME



1. The sun is higher at noon in summer than in winter. 2. It might seem that if someone took a snapshot of the noon sun every month, the images would line up one above another. 3. Actually they would line up as shown here because the sun is exactly south at noon by the clock only four days a year. On all other days it is a little early or a little late. 4. This happens partly because the earth does not travel around the sun at a steady speed, as explained in the article. The gray areas here are equal, and a line connecting the earth and sun sweeps over these in equal times. But the earth travels much farther at A than at B.

The United States has kept standard time since 1883, when a General Time Convention, sponsored by the railroads, adopted it. Congress passed the Standard Time Act, recognizing standard time as the nation's official time, in 1918. In North America the time zones are based on the following meridians:

Atlantic—60° W., passing west of Newfoundland.

Eastern—75° W., passing through Philadelphia.

Central—90° W., passing almost exactly through New Orleans and East St. Louis.

Mountain—105° W., passing almost through Denver.

Pacific—120° W., passing near Carson City, Nev., and forming the eastern boundary of California in the north.

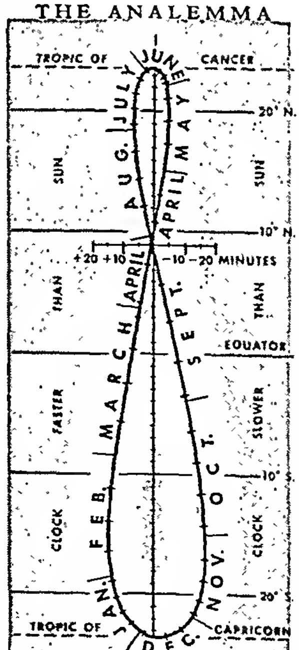
Yukon (Canadian)—135° W., passing near White Horse.

Alaska—150° W., passing near Anchorage. (For a map of the time zones in the United States, *see* United States.)

In addition to being inconvenient, as already explained, apparent time is not steady. The sun does not cross the meridian at exact intervals of 24 hours every day in the year. At certain times of the year it crosses earlier than noon, and at other times later. There are several reasons for this.

The sun's apparent motion is due to two causes. The rotation of the earth on its axis makes the sun seem to move *westward* around the earth every day. And the revolution of the earth around the sun makes the sun seem to creep slowly *eastward* among the stars. (Of course, we cannot see the stars during the day and so we do not sense this motion.) Now the earth's rotation is perfectly steady, but its revolution is not. The sun is not quite in the center of the earth's orbit, and when the earth is close to the sun it moves faster than it does when it is farther away. This makes the sun seem to speed up and slow down in its yearly eastward motion. Accordingly, it is usually a little late or a little early in reaching the meridian at noon by the clock. (The earth's speed of revolution varies according to a rule of astronomy known as Kepler's second law. This says that a line connecting earth and sun sweeps over *equal areas* in *equal times.*)

THE ANALEMMA



The analemma printed on globes shows the noon position of the sun through the year. One scale shows the difference between clock and solar time. Another helps to figure the sun's height.

One other important factor affects the time of apparent noon. The sun does not travel straight east in its apparent yearly motion. It goes along a circle called the *ecliptic*, as explained in the article on Astronomy. Traveling along this path, the sun "wastes time" by moving north or south during parts of the year. For timekeeping we are concerned only with its eastward motion, and so it seems to slow down at these times.

To keep apparent time, clocks would constantly have to be speeding up and slowing down. In order to avoid this, astronomers figure the *average* length of the day (from noon to noon) during the year. This is divided into average hours, minutes, and seconds, and clocks are set to run according to these figures. This "average" time, is called *mean solar time.* Standard time according to the zone system is kept in mean time.

The difference at any moment between apparent and mean time is called the *equation of time.* This is the number of minutes which must be added to or subtracted from apparent time to make it equal mean time. A sundial keeps apparent time, and the equation of time must be applied to its reading to show mean time. Globes have *analemmas* which show the correction needed for different times in the year.

Correct mean time in any locality in the United States can be learned by checking with time signals from the Naval Observatory in Washington, D.C. The signals are carried by telegraph companies and naval radio stations. The article on Observatory tells how astronomers establish time by the stars. In summer many communities

set clocks ahead of standard time to "save daylight" (*see* Daylight-Saving Time).

Different Systems of Timekeeping

In addition to apparent and standard time, astronomers use *sidereal time* for certain purposes. A sidereal day is the time between two successive crossings (transits) of the meridian by a particular star. This is equal to 23 hours, 56 minutes, and 4 seconds of mean solar time. A day measured by this system has the same length throughout the year because it depends only on the steady rotation of the earth and not on the irregular apparent motion of the sun. But sidereal time cannot be used for ordinary purposes because a sidereal "noon" or any other time of day would come about four minutes earlier each day.

The 24 hours of the day are usually divided into two groups (A.M. and P.M.) of 12 hours each for timekeeping. But many countries use a 24-hour system, particularly for their railway schedules. In this system the hours begin with zero at midnight and run through 23. Thus 10:30 A.M. is simply 10:30 and 10:30 P.M. is 22:30. The armed forces of the United States use a similar system, as do most navigators.

On shipboard two varieties of time are kept. An accurate chronometer runs according to Greenwich Civil Time (standard time of Greenwich, England). This is used only for navigation. The regular clocks of the ship are set according to standard time of the zone in which the vessel is cruising. On some ships bells are struck at half-hour intervals to mark the progress of a four-hour "watch" (*see* Ships). "Eight bells" marks the end of each watch.

TIN. The largest use of this metal is in coating steel to protect it. The billions of tin cans we use every year are made of tin plate because tin is resistant to food acids. A coating of tin which is only 0.00003 inch thick is enough for this purpose. Steel for cans is plated by dipping sheets of it in molten tin or by passing continuous strips on high-speed rubber rollers through an electrolytic tinning bath. Kitchen utensils are electroplated with a thicker coat of tin (*see* Electroplating). Terne plate for roofs is made by immersing sheets of steel in a molten mixture of lead with 15 to 25 per cent of tin.

Tin enters into many alloys, such as bronze, babbitt and other bearing metals, type, solder, pewter, and various low-melting-point alloys (*see* Alloys). Alloys of tin are used to make collapsible tubes such as those for tooth paste. Tin chloride is used in dyeing and weighting silk.

Pure tin is bluish-white. With a specific gravity of 7.3, it is heavier than zinc. In hardness it is between lead and gold. The melting point is 449°F.; boiling point, 4,100° F.; valence, 2 and 4.

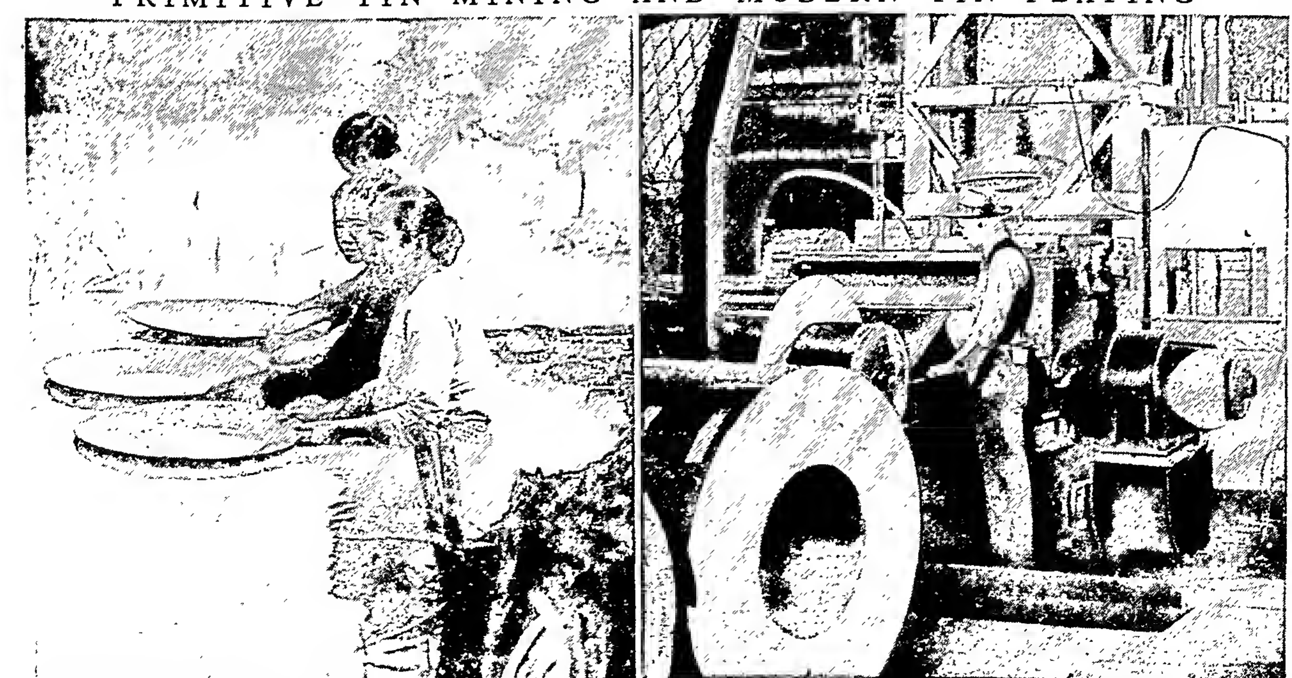
Principal Sources of Tin

The chief ore is cassiterite or tinstone, a dioxide of tin. Before smelting, it is crushed to a powder and roasted to remove arsenic and sulphur. At the smelter, it is heated with carbon to separate the tin from the zinc, copper, bismuth, and iron that it contains. Tin is also refined by electrolysis. The refined product is called "block tin."

Malaya leads in tin-ore production, followed by Bolivia and the East Indies (Indonesia). China, Australia, England, Nigeria, Belgian Congo, Burma, and Siam (Thailand) also yield commercial quantities.

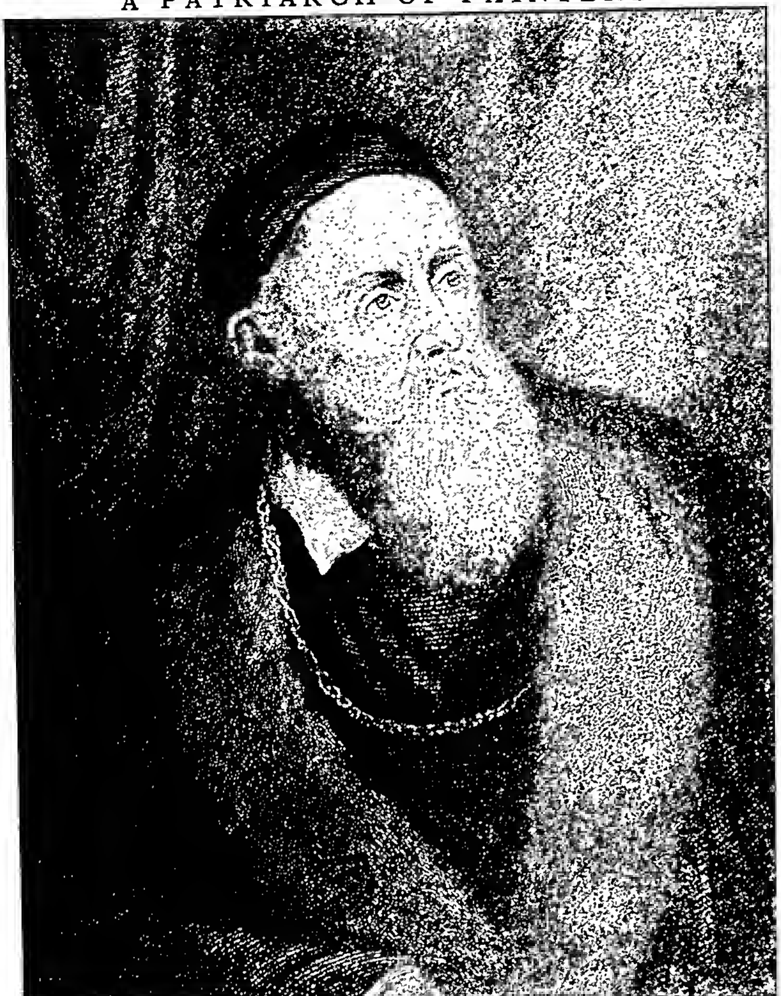
Although the United States is the world's largest user of tin, it has no important deposits. Alaska,

PRIMITIVE TIN MINING AND MODERN TIN PLATING



At the left native girls pan tin in the Malay States. The tin, which is found in alluvial deposits, may also be extracted by machinery. The right-hand picture shows the modern method of tin plating. Flakes of tin are deposited on steel strips and then fused electronically into a smooth coat. The finished rolls in the foreground will later be cut into sheets.

A PATRIARCH OF PAINTERS



Titian might be called the "Grand Old Man" of the Renaissance. At 98 he was still a vigorous painter with the humility of a novice toward his work.

the chief domestic source, produces but little. Most of its imports of refined tin come from smelters in Singapore, England, and Indonesia.

When the second World War threatened to cut off supplies of this "strategic material," the United States in 1941 erected at Texas City, Tex., its first large-scale commercial tin smelter, to produce tin from the low-grade ores of Bolivia. Smaller tin smelters built in the United States had failed because it was cheaper to buy refined tin from abroad than to produce it from imported ores.

The use of tin in the form of bronze, an alloy of tin and copper, began thousands of years ago (*see* Bronze). Since deposits of this metal were hard to find, it became an important factor in early commerce. To get it, the Phoenicians sailed from the Mediterranean as far as the mines of Cornwall in distant Britain.

TITIAN (*tĭsh'ăn*) (1477–1576). The old artist laid down his brush and gazed at the masterpiece before him in which he had just revealed the golden splendor of 16th-century Venetian life.

"I think," he said simply, "I am beginning to learn something about painting."

It was Titian who spoke—Titian, the great Venetian painter who at the age of 98 was still painting, and who during his long life of industry, success, and honor produced more than 600 pictures, glowing miracles of color, many of which today are numbered among the greatest art treasures of the world.

The great artist, whose Italian name was Tiziano Vecellio, was born at Cadore, in the Alpine region north of Venice. When just a little boy of ten he left his mountain home—where, legend tells us, he used to paint with juices extracted from flowers—and went to study painting in Venice. There he worked in the studios of Giovanni and Gentile Bellini, where the artist Giorgione was a fellow pupil.

Titian's pictures soon brought him fame, riches, fine friends, and many honors. In 1513 he became superintendent of government works, which office brought him a comfortable income. In return he was to complete certain great works begun by Bellini and paint the portraits of the Venetian doges or rulers, as they succeeded one another in office. He was a handsome man of courtly manners, who soon associated on terms of comparative equality with dukes and kings and princes of the church. His portraits of these famous men are among his greatest works. His first portrait of Charles V so pleased that great emperor that Titian was made a count and Knight of the Golden Spur, while Titian's children were raised to the rank of nobles of the empire. Meanwhile the artist was producing many great works of religious and mythological subjects. Among the most famous of these are 'The Assumption of the Madonna', 'Christ and the Pharisee', 'Bacchus and Ariadne', 'The Entombment of Christ', 'The Supper of Emmaus', 'Venus Anadyomene', 'The Holy Family with Adoring Shepherd', 'St. John the Almsgiver', 'Christ Crowned with Thorns', 'Presentation of the Virgin in the Temple'.

In 1530 at the death of his wife, Titian established himself in a beautiful new home on the sea at one end of Venice, where he was the center of a famous artistic and literary circle, joined even by kings. Here, at the age of 99, he fell a victim to the terrible plague which at that time killed 50,000 persons in Venice. He was buried with honors in the church of Santa Maria de' Frari.

Titian is looked upon as the greatest color artist of all time. In his fine portraits of emperors, queens, popes, doges, and fair women—and in his gorgeous church pictures glowing with exquisite harmonies of color, and his paintings of enchanting pagan deities amid their beautiful nature settings, he

has revealed the glittering pageantry of 16th-century Venice, that luxury-loving city of palaces, domes, and marble porticoes, dreaming in golden splendor beside the blue Adriatic.

TITLARK. The pipit, as the American titlark is commonly called, is a "near-lark." In its plumage of streaked brown, as in its habit of singing on the wing and of nesting on the ground, it closely resembles the lark family.

More than 50 species of pipits, with the wagtails, make up the family *Motacillidae*, and occur in all parts of the world. Two of these species are common in the United States. The common pipit, 6½ inches long, is found in open country and wet fields. It feeds mainly on worms and insects. Its repeated call, *pipit, pipit,* has given it its name. In the fields or prairies flocks of hundreds are often found running on the ground. (For illustration in color, *see* Birds.) Sprague's pipit, because of its lovely song while on the wing, has been given the name of "Missouri skylark." Scientific name of common American pipit, *Anthus rubescens;* of Sprague's pipit, *Anthus spraguei.*

TITMOUSE. Orchard owners largely depend for a successful fruit crop on the help of the active little titmouse. When trees are bare and sprayers rest from their war against the insect menace, these little experts get in their best work. They search every crevice for hibernating insects, and the larvae and eggs from which harmful insects hatch. Then, when spring brings out the fruit blossoms, the wise titmouse knows which bud contains the harmful grub, and fruit growers have learned that these are the buds the birds destroy. So sprightly, bold, and inquisitive are these birds that one writer has aptly described them as "feathered interrogation points."

The plumage of the titmouse family (*Paridae*) is never spotted, barred, or streaked. Plain colors are the rule, usually gray, olive green, or brown above, and lighter shades underneath. Some species of the titmouse family, notably the chickadees, have caps of contrasting color (*see* Chickadee). All possess short cone-shaped bills and blunt tongues that have horn-like bristles at the tips. Some species are crested. Though they are classed as song birds, they are not necessarily singers, but all have cheery and musical call notes. As a rule, they do not migrate, though they roam widely in search of food. They are found

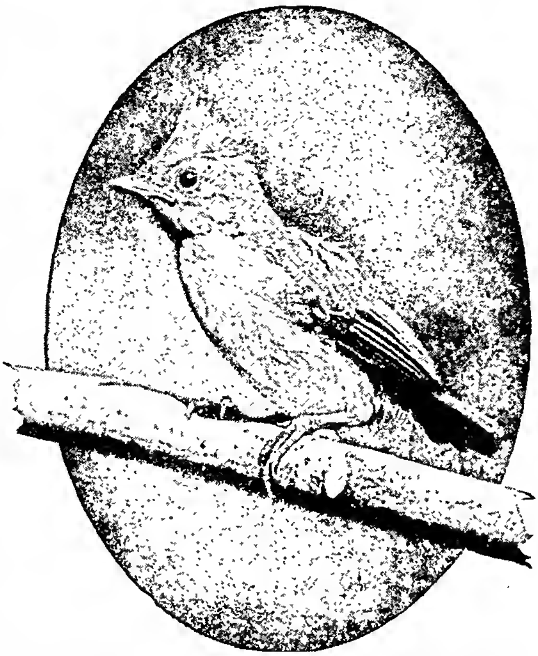
'THE ASSUMPTION OF THE MADONNA'

This oil painting, one of the great works of Titian, was unveiled in 1518 at the church of the Frari in Venice. The figures of the apostles are nearly nine feet tall. When Napoleon was carrying off art treasures from Italy to Paris, this picture was blackened over with candle smoke so that the French would not consider it worth taking away. Thus it remained in Venice, the city which nurtured the brilliant painter.

throughout the Northern Hemisphere. They nest in hollow trees or stumps. The six to eight eggs are white, marked with reddish brown or rust color.

The tufted titmouse of the midwestern and eastern states and the several closely related western species are jaunty, friendly little birds with a most engaging curiosity. They are about six inches long, and wear a pert crest. The forehead is black, the body slate gray above and white beneath, washed on the sides with reddish brown. Titmice live in thin woodlands, which ring all day long to their loud clear call of *peto, peto, peto*. They line their nest with hair and sometimes use daring means to get it. They will snatch a mouthful from the tail of a squirrel and have even been known to tug at hair firmly attached to human heads. The nest is placed in deserted woodpecker holes or in hollow stumps.

YOUNG TUFTED TITMOUSE



Only a day or two out of the nest, he already has his parents' pert expression and impudent manners.

The bush tit is but four and a half inches long, brownish gray above, dull white beneath. Its nest is a gourd-shaped basket, from eight to ten inches long, made of leaves and moss, with a soft lining of spiders' webs and feathers. The entrance is from the side. These birds are found on the Pacific coast from British Columbia to Lower California.

The verdin lives along the Rio Grande, the Colorado, and other river valleys of the southwest. It is the only brightly colored member of the family, with waxy yellow head, neck, and chest, reddish shoulder patches, gray back, and white underparts. The nest, built amidst the bare vegetation of the desert, is cleverly camouflaged as a bit of drifting weed caught in the branches. The birds sleep in the old nests on winter nights, but build new ones in the spring.

About 300 species and subspecies of titmice are known, of which only about 40 are North American. They belong to the family *Paridae*. Scientific name of tufted titmouse, *Baeolophus bicolor;* of bush tit, *Psaltriparus minimus;* of verdin, *Auriparus flaviceps*.

The LIFE STORY *of the* COMMON TOAD

TOAD. Springtime breaks the long winter sleep of the toad, sluggish cousin of the frog. He stirs in his cozy niche under clods or stones, then half crawls, half hops into the spring sunlight, which catches glints of gold, amber, and jade in his protruding eyes.

The common American toad, when full grown and perhaps 25 years old, may be three and a half inches long. His skin is rough, with prominent warts. He is brownish-olive in color, usually with some darker spots, and with a yellowish streak down the middle of his back.

He is different from the frog in many ways. His jaws are toothless, for he lives mostly on creatures that he can swallow at one gulp. His legs are shorter and only when he is frightened will he take a full leap. He spends most of his life on land; and so his feet are not as fully webbed for swimming as are the frog's feet.

In summer the toad sits and sits, his sides getting fatter as he fills his stomach completely with live insects four times in 24 hours. He captures them by flipping out his sticky tongue so fast that the eye can scarcely detect it. He may swallow nearly 10,000 in a season, and ranks as an excellent garden protector. Besides slugs, beetles, flies, mosquitoes, crickets, cutworms, plant lice, and sugar-beet worms, he also relishes earthworms. These give the toad a real battle. With his forefeet he wrestles the worms inch by inch into his mouth and then swallows them whole.

HOW A TOAD SINGS

This toad shows us how he puffs out his vocal sac and sings with his mouth closed. He serenades the females with his song, a long and piping trill that in spring haunts the marshes with plaintive music.

Its Skin Is a Weapon

When alarmed, the toad puffs out his body until the skin is taut. Like other tailless amphibians (animals that live on both land and water), the toad has active glands in his skin from which a milky, acrid secretion oozes when he is roughly handled. A dog will promptly drop a toad from his mouth. The acrid secretion will not hurt a human being unless he gets it into his mouth or eyes. The belief

held by many people that you can catch warts by handling a toad is a superstition.

The Song of the Toad

During the hot days of May or early June (April in the South), the toad moves with many others of his kind to some quiet pool and serenades the females. They are larger than the males, and they cannot sing. Their brilliant eyes showing from the water, they listen as the male fairly bursts with hoarse gulps. His resonating vocal sac swells up into a balloon larger than his head, for he keeps his mouth and nostrils closed while the air is driven back and forth between lungs and mouth.

Eggs and Tadpoles

After a few days, the female lays her eggs, often thousands at a time, in shallow, quiet water. The small black eggs are arranged like strings of beads in long double cords of clear jelly. In two or three days if the weather is warm, and in a week if it is cool, the eggs hatch out into small stumpy tadpoles. These are much smaller and darker than the tadpoles of the frog, but they have a similar life history (*see* Frog). Fish, water beetles, crayfish, turtles, herons, and other creatures are waiting hungrily to devour the tadpoles, and only a small proportion of them reach maturity. In four to six weeks, the surviving tadpoles are an inch long. It now takes them only a few days to turn into toads.

The new toads, who have shrunk to about the size of a kernel of corn, leave the water and go hopping away in search of mosquitoes and other small insects. By day, the little toad hides from his many new enemies—snakes, crows, hawks, chickens, and ducks—as best he can. At night, he comes out to eat and to migrate farther and farther from his home pool. By fall his body is again an inch long. Then he goes to sleep for the winter. When he is about three years old, he makes his first trip to a pool for the annual serenading and egg-laying.

Caring for Tadpoles and Toads

Many persons find toads interesting pets. Others like to watch the change from egg to tadpole to toad. A few dozen of the eggs can be placed in a shallow dish full of water, with some pond mud on the bottom. After the tadpoles are hatched, pond scum should be added occasionally to feed them. When the tadpoles are an inch long, a miniature landing place should be provided so that they can come up and finish developing into toads. After this takes place, they must be transferred to a covered cage.

Toads are found not only on all the continents (except the Antarctic) but on many islands as well. Some 30 kinds live in the United States, but most of them are found in only a few places. The so-called "horned toad" of the desert regions of the Southwest is not a toad, but a lizard (*see* Lizards).

Some Odd Habits of Toads

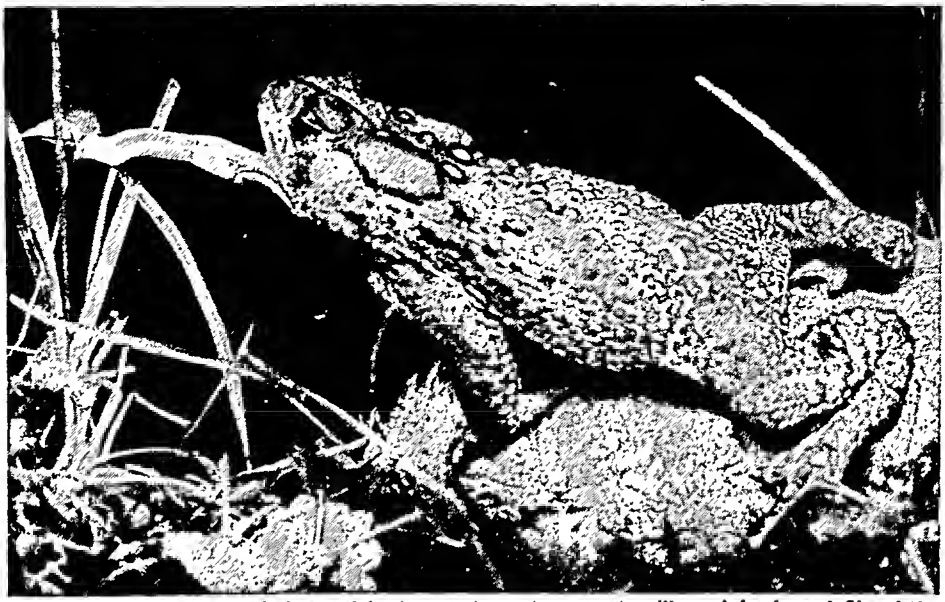
In northeastern South America is the huge, flat Surinam toad, which has no tongue and spends its life in the water. When the eggs are laid, the male distributes them evenly over the back of the female, and under each egg a deep pouch forms in the skin to hold it. Within this cavity, the egg develops through the tadpole stage; then the young one, fully changed into a toad, swims away from its mother.

The female of the midwife toad, a European species, has no further responsibilities after she has laid her eggs. The chains of eggs are taken by the male and wrapped around his legs and thighs. He assumes the care of the eggs during the entire three weeks of their development.

In Colombia, the Indians use the secretion of a highly colored toad in "dyeing" parrots. The blue and green feathers on the neck of the Amazon parrot are plucked out, and the bare skin of the bird is touched with the skin of a living toad. This is repeated again and again after the young feathers begin to appear. When the feathers at last grow in, they are a brilliant yellow instead of green.

The Orientals use toadskins in making small articles such as purses. In Chinese medicine various parts of the toad are used for compounding prescriptions.

THE TONGUE IS A STICKY INSECT TRAP



Here a toad flashes out his long sticky tongue to capture a caterpillar. A backward flip of the tongue, and the insect will be trapped in the toad's mouth. It is easy for him to flip out his tongue because it is attached to the front of his lower jaw and is free behind.

Toads, together with frogs and salamanders, belong to the class of backboned animals known as *Amphibia*. Scientific name of the common American toad, *Bufo americanus*. Closely resembling it is *Bufo lentiginosus*, the species most plentiful in the Southern states. Scientific name of the Surinam toad, *Pipa pipa;* of the midwife toad, *Alytes obstetricans*.

TOBACCO—*A Big* MONEY CROP

This picture, taken in North Carolina, shows a tobacco plant in full bloom. Usually the buds are cut to prevent flowering.

TOBACCO. Two men who sailed with Christopher Columbus were the first white men to see tobacco being smoked. In November 1492 these sailors reported to their captain that in Cuba they had seen natives perfuming themselves with the smoke of fragrant leaves. The Indians lighted the leaves at glowing coals, held them to their mouths, and inhaled the smoke. They were probably smoking a crude sort of cigar.

Indians throughout the Americas used tobacco during tribal ceremonies or as medicine. North American tribes smoked it in stone or clay pipes. The Pimas of Arizona smoked "cigarettes" made by filling reeds with tobacco. South American Indians inhaled powdered tobacco, or snuff, through the nose. Some tribes chewed the leaves.

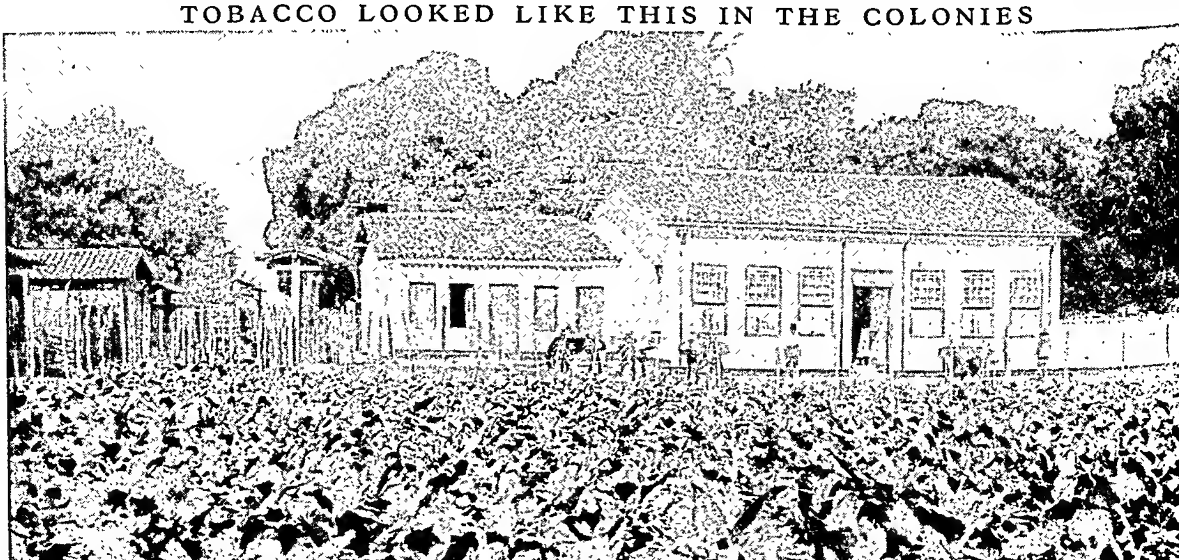
Europeans carried home both the plant and the various ways of using it. Tobacco became popular in Europe first as a medicine and then as a luxury. The new habit met violent criticism. King James I of England published a pamphlet called "A Counterblaste to Tobacco." Critics declared that indulgence in tobacco was both harmful and barbaric. Its use spread steadily despite opposition.

Spaniards established tobacco plantations in the West Indies in the 16th century. Colonists in Virginia began its successful cultivation in 1612 under the leadership of John Rolfe. Tobacco was the first commercial crop of the American Colonies and was their chief export for many years. Production gradually spread to many parts of the world.

Governments quickly learned that people would pay high taxes for the privilege of using tobacco. Queen Elizabeth I of England imposed an import duty on tobacco, and James I increased it 4,000 per cent. The cultivation, preparation, and sale of tobacco became a government monopoly in France in 1674. Turkey and most European countries operate tobacco monopolies today. Where the industry is not state owned, taxes are so high that a large part of the price of any tobacco product goes to the government.

Today farmers in the United States usually plant about 1¾ million acres in tobacco and raise 2 bil-

TOBACCO LOOKED LIKE THIS IN THE COLONIES



Here we see a tobacco plantation near São Salvador, Brazil. Botanists say that the tobacco grown in this region is more like the tobacco raised in colonial times than any other type known today. Tobacco experts call it one of the best varieties.

lion pounds. Acreage throughout the world totals about 8 million, with a yield of 7 billion pounds.

The United States (in 21 states) raises more tobacco than any other country. It also uses more. The Indian peninsula ranks next in both production and consumption. Other important producers are China, Russia, Indonesia, Japan, Germany, Turkey, France, Belgium, Italy, Greece, Hungary, Cuba, Puerto Rico, the Philippines, Mexico, Brazil, and Canada.

READY FOR THE AUCTIONEER

Most tobacco in the United States is sold at auction. The tobacco in this warehouse is stacked for sale. Each stack is a "lot." The auctioneer and buyers will walk up and down the aisles between the lots as the selling progresses.

The Tobacco Plant

Tobacco belongs to the nightshade family and is therefore related to the potato and tomato as well as to the deadly nightshade. Its genus name is *Nicotiana*, after Jean Nicot, French ambassador to Portugal in 1559–61, who sent specimens to Francis II and his mother, Catherine de' Medici. A South American species, *Nicotiana tabacum*, supplies the commercial varieties today. The original species of the American Colonies was *Nicotiana rustica*.

The tobacco plant is coarse and rank, with large leaves drooping from a central stem. Short hairs cover the green parts and give off a sticky secretion. The flowers, appearing in a cluster at the top of the stalk, are large, sweet scented, and range from deep pink to nearly white. Most of the buds are cut off before they open so that all nourishment will go to the leaves. The tiny seeds are black.

Tobacco plants are grown from seed in a cold frame. The seed bed has to be kept at just the right degree of humidity and temperature and the ventilation has to be carefully controlled. The plants need considerable hand labor at every stage from transplanting through cultivating and harvesting. In addition, the land needs thorough preparation and fertilizing. Alternation of crops is almost a necessity. In the early days of tobacco production, year after year of tobacco raising wore out the soil in many sections of Maryland and Virginia.

Different Varieties for Different Uses

Tobacco is hardy. It thrives from the tropics to as far north as Quebec. It is very sensitive, however, to differences in climate and soil. Seed of the same species planted in different places produces varieties suitable for different purposes.

Farmers in the Connecticut Valley and small areas of Georgia and Florida raise a smooth fine tobacco in the shade of cheesecloth tents. It is used for the outside wrappers of cigars. Wisconsin and the Connecticut Valley lead in producing "binder leaves," or inside wrappers for cigars. Cigar filler comes mainly from Pennsylvania and the Miami Valley of Ohio.

A bright-leafed tobacco (flue-cured) is the most important cigarette type and the most widely grown tobacco. It is raised in the Carolinas, Georgia, Virginia, Florida, and Alabama. Enormous quantities are exported. Burley, a light tobacco for chewing, for cigarette blends, and for pipe mixtures, is an important crop in Indiana, Kentucky, Ohio, Tennessee, and West Virginia.

Virginia, Kentucky, and Tennessee raise a dark variety (fire-cured) chiefly for snuff but also for chewing and for pipe mixtures. Most of it is exported. Perique, a black, strong type used sparingly in pipe mixtures, is grown in one parish in Louisiana.

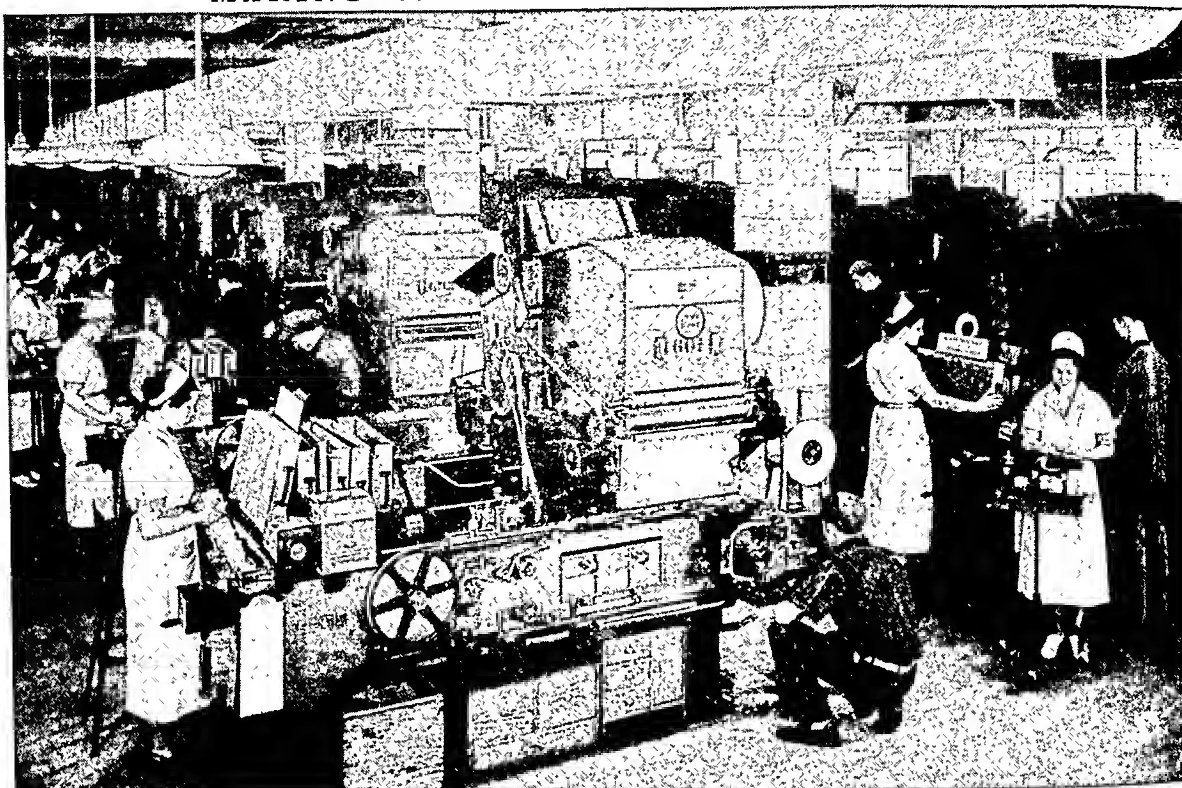
The tobacco leaf of Cuba called Havana is world famous for its aroma. It makes excellent cigars. The mild tobaccos of central and northern Europe are used principally in pipe mixtures. Turkey and the Balkans (particularly Greece and Bulgaria) produce a small-leafed aromatic tobacco which goes into so-called "Turkish" and "Egyptian" cigarettes. The Japanese grow tobacco with large dark leaves, used in cheap cigars. China exports a light-tissued flavorless leaf utilized to give a bright tint to other tobaccos. Indian tobaccos go principally into cigars.

Curing Gives the Flavor

The tobacco leaf is green when harvested and does not have the characteristic color and flavor until it is cured. Curing includes drying, fermenting, and aging.

Tobacco may be dried in the sun. This method produces a sweet tobacco for chewing. Air drying is the usual method for Burley and cigar tobaccos. The

MAKING CIGARETTES THE MODERN WAY



Each of the cigarette-making machines shown here turns out more than a thousand cigarettes a minute. The cigarettes leave these machines in trays to go on an overhead conveyer to packaging machines.

leaves are hung in a barn or tobacco house so constructed that ventilation can be carefully regulated. A third method of drying is by artificial heat—open fires or flues. The dark, mottled-brown leaves produced in western Tennessee and Kentucky are cured over open fires. This gives them a characteristic smoky odor. In flue-curing, the fires are outside the sheds, and the heat is brought in by flues or iron pipes. This process results in the bright yellow leaves so widely used for pipe, cigarette, and chewing tobacco.

The dried leaves are brittle and would crumble with handling. They are exposed to natural or artificial humidity until they again become soft and pliable. Then they are sorted, made up into small bunches, and fermented by being piled in stacks five or six feet high. After fermentation the tobacco is graded and packed. It is sometimes aged in a warehouse for four or five years to make it more mellow.

A few of the most expensive cigars and cigarettes are made by hand, but machinery is used for most cigars and popular brands of cigarettes, as well as for chewing and smoking tobacco and snuff. Often the tobacco is flavored and given an artificial aroma with "sauce" made of licorice, spices, and glycerol or other chemical with moistening qualities.

The principal centers for the production of tobacco products in the United States are Durham, N. C.; Reidsville, N. C.; Louisville, Ky.; Richmond, Va.; Philadelphia, Pa.; and Tampa, Fla.

Tobacco contains small amounts of nicotine and other alkaloids. Its use has sedative and habit-forming qualities. Opinions differ as to other effects of smoking.

TOKYO (*tō'kyō*), JAPAN. When Japan's chief war lord of the early 17th century rose to power, he chose a little-known town on the island of Honshu as his headquarters. His choice was shrewd. The small settlement grew into modern Tokyo, capital of the Japanese empire and third largest city in the world.

The key to Tokyo's giant growth lies largely in the city's location. It is at 35° 41′ north latitude, on about the same parallel as Memphis, Tenn. It stands at the head of sheltered Tokyo Bay in the center of the east coast of Honshu, Japan's "main island." Around it lies the Kwanto or Tokyo plain, the largest lowland in Japan, which supports some 14 million people. The city is their gateway to the outer world. The Pacific lies only 35 miles away, and 10 miles down the bay on the way to the ocean stands the great deep-water port of Yokohama to handle and dispatch the commerce of this region.

Tokyo grew into a sprawling city. It curves around the bay like a rough crescent, spreading over approximately 100 square miles, about half the area of Chicago. From its crowded water front on the tidal flats, it stretches back north and west to low hills. The winding Sumida River and branching canals twist through the lower districts. About 70 miles to the southwest rises snow-crested Fujiyama. Waterfalls

in the mountains provide hydroelectric power for the city. Many factories operate by electric power, and even the poorest homes have electric light.

Ultramodern Buildings Rise from Ruins

Until recent times the city spread out without plan. It was a jumble of narrow streets crowded with wooden buildings. Flimsy bridges crisscrossed the canals. Then, in 1923, a devastating earthquake and fire destroyed nearly half the city. Within seven years a new Tokyo rose from the ruins. To reduce the risk of another sweeping fire, Tokyo widened its chief streets, and cleared several areas for parks. Wooden bridges gave way to concrete spans, many built in the graceful arch design so admired by the Japanese. Most of the structures in the business district, stretching from the waterfront to the center of the city, were designed to withstand earthquake shocks. Many were ultramodern in appearance, designed by American architects, with frames of steel and concrete. Schools and factories also were modernized, with balconies and roofs built to serve as outdoor gymnasiums for the compulsory exercise of students and workers.

But most of the people still lived in cramped side streets and alleys, heavy with the odor of fish and pickled vegetables. Twice a year the police supervised a general housecleaning. Every householder had to scour everything in his house, for the Japanese dread dirt as a source of deadly Oriental plagues.

Their one-story frame houses were like thin boxes, with bamboo shutters, and usually roofed by tile. Often the walls were paper. Yet generally the only heat was a charcoal burner. Frost is rare, but the frequent winter winds sweep shivering Tokyo with damp, cold ocean air. Summer heat is oppressive, and the annual rainfall of 41 inches gives the city many wet days.

Many Districts Displayed Rare Beauty

In the better residence districts toward the outskirts, Tokyo was a city of beauty. Many homes were rebuilt in "Western style," but the people largely kept their old customs. Even in modernized houses, the residents often dressed in the traditional kimonos, and furnished their rooms with austere artistry. Behind nearly every home, stone walls sheltered a garden with a miniature lake, tiny bridge, and dwarfed pine trees. Cherry trees lined the avenues and parks. In April they were showers of pink bloom. Temples dotted the wooded hills.

On a low hill in the center of the city, next to the modern business district, stood the imperial palace. Its temple-like buildings were surrounded by a double line of moats. The massive, stone retaining walls were crowned with gnarled old pines.

This city, at once old and new, is the heart of Japan. For many years all distances in the nation were measured from the Nihon-bashi (Bridge of Japan) across the Sumida River in the financial district. Japan's great network of railways fans out from Tokyo's central station near the waterfront. Japan's business life centers in the Ginza, Tokyo's main avenue, and neighboring streets. About a fifth of Japan's industrial goods are made in Tokyo factories. Nearly all eminent Japanese live here, and every ambitious Japanese student seeks to complete his education by studying in Tokyo. The city has three large universities—the Imperial, and the private universities of Waseda and Keiogijuku.

Tokyo Sprang from a Fishing Village

Tokyo is a young capital. For centuries it was only a fishing hamlet, called Yedo. But in 1603 the warrior Tokugawa selected it as his administrative center, and there founded the Shogunate which dominated Japan until overthrown in 1868. The next year the emperor of Japan made it the national capital. He changed its name to *Tokyo*, meaning "eastern capital," as opposed to Kyoto, the western capital, which he had forsaken after Japan admitted American trade.

Few great capitals have suffered such violence. Each autumn typhoons lash it. Frequent earthquakes jar it through the year. Fire annually levels thousands of flimsy homes. In the second World War, American bombs destroyed a large part of the city and forced many residents to flee. Only modern steel-and-concrete buildings withstood the blasts and flames. (*See also* Japan.) Population (1950 census), 5,385,071.

TOLE'DO, OHIO. Growth and prosperity have come naturally to Toledo because this city occupies a fine geographic location for the development of commerce and industry. It is situated at the western end of Lake Erie near the mouth of the Maumee River. To the north and west lie the mineral and agricultural resources of five Great Lakes states. To the south and east is a region thickly populated and rich in varied products. The city's position makes it a natural distributing point.

Toledo is one of the busiest ports on the Great Lakes. It is the world's greatest shipper of soft coal, handling about half of the cargo coal carried by lake vessels. This coal comes to Toledo from the mines of Ohio, Kentucky, and West Virginia, and much of it is transferred to boats at Toledo's docks. These docks also handle inbound cargoes of iron ore and grain from Lake Superior and Michigan ports. The city is also served by 16 main railroads, three major air lines, and bus and truck lines.

Toledo's many products include automobiles, automobile accessories and parts, machines and machine tools, electrical appliances, weighing scales, processed food, and gasoline and fuel oil. Toledo's large output of glass products has earned it the title Glass Capital. It has some of the nation's largest oil refineries. Pipe lines bring petroleum from the mid-continent field, mainly Texas and Oklahoma.

Toledo has many parks and playgrounds. Outstanding is Walbridge Park, with one of the nation's large municipal zoos. The city has a library composed of a main building and ten branches. Among other educational institutions are the Museum of Art and the University of Toledo, maintained by the city.

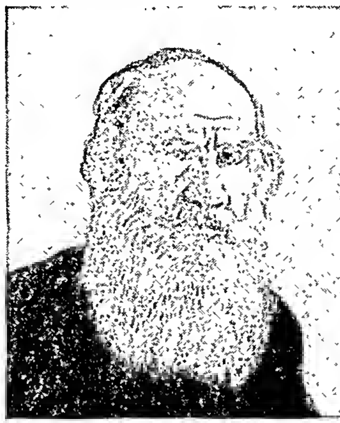
In 1935 Toledo adopted the city-manager plan of government. A council of nine members, elected by proportional representation, determines the policy of

the government. The council elects a city manager who carries out its policies. From 1897 to 1913, the city became known for its fight against machine politics under reform mayors Samuel M. ("Golden Rule") Jones and Brand Whitlock. The Toledo Labor-Management-Citizens Committee promotes peaceful employer-employee relations. In 1946 Toledo enacted a city income tax.

Toledo stands on the site of old Fort Industry, built in 1794. The city was founded in 1833 and named after the old Spanish city. After a boundary dispute between Ohio and Michigan in 1835–36, the city remained in Ohio. It grew rapidly after the opening of the Wabash and Erie Canal in 1843 and the Miami and Erie in 1845. Population (1950 census), 303,616.

TOLSTOY (*tŏl-stoi'*), COUNT LEO (1828–1910). Few men of modern times have had a greater influence on the world's thought than Tolstoy. His novels are models of power and realism; his social ideas sent out ripples to all parts of the world.

COUNT LEO TOLSTOY



Few men in history have exercised so profound an influence upon their native land as Tolstoy exercised upon Russia.

He was born in 1828, the fifth child in a noble family of Russia. In his book called 'Childhood' he gives the recollections of his life in the country, of learning to ride horseback, of trying to fly by jumping out of a second-story window. At school in Moscow he early gave promise. His tutor said, "That youngster has brains; he is a little Molière." But the young Tolstoy had qualities which were greater than mere brains. Even in his early days he sought for truth through all sorts of speculation, and not only did he seek it, but he put it into practice.

Unluckily for his own peace of mind, however, Tolstoy had another side to his nature which was equally strong. He loved pleasures of all sorts: dancing, feasting, drinking, good company. In other words, he was like all the other young Russian nobles of his day, who were more or less dissipated. A visit to the Caucasus seems to have turned his thoughts to soberer things, and in 1852 he joined the army. The great amount of leisure drove him to write down some of the thoughts that tormented him for expression. 'Childhood' was the first of a series of stories which appeared within the following two years.

In 1854 Tolstoy entered the Crimean War as an officer. His experiences there gave him a great fund of material. The 'Sebastopol Sketches' exposes not the glory but the grim horror of war. His campaigns there gave him the basis for his story of Napoleon's invasion of Russia called 'War and Peace'. Various other novels, among them 'Anna Karénina', appeared at intervals during the years.

Although Tolstoy was acclaimed as a great writer, there were many reasons why fame did not satisfy him. Even in the earliest days he had tried to relieve the dreadful distress and poverty of the Russian peasants. He had taught in a school himself, he had tried to send a message to the world through his novels. But there the rigid censorship held him back. He had severed his connection with the orthodox Russian church because he did not think it expressed truly Christian teachings. Had it not been for the love and veneration in which the people held him, he would surely have been exiled for his liberal views and teachings.

In 1891 Tolstoy had crystallized his beliefs as follows: To be perfectly pure; to be perfectly free (not to take oaths); never to use violence for the protection of one's self or others, even against an animal; to do good to one's enemies. To carry out such a program of life would be impossible as society is constituted now. But Tolstoy with his accustomed fervor tried to put his beliefs into practice. He made shoes for a living, became as simple in his habits as a peasant, and divided his wealth among the members of his family.

During and before this period he wrote powerful articles setting forth his views. 'The Kingdom of God Is Within You' was brought to America and England, where it was published. In Russia it was forbidden. He even simplified his art to the writing of fairy stories for children.

Tolstoy died in 1910, mourned by all the world. Many people did not agree with him and yet even to them he was an inspiration. He made plain the evils of the day. His writings are in large part a revelation of the soul of the Russia of the later 19th century. They reveal its idealism under a harsh exterior, its childlikeness, its depressions and exaltation, its militant zeal coupled with a [illegible] of war and force, its care for human worth in the midst of a brutal and debasing autocracy. Tolstoy helps us to understand the nation which plunged in eight months from the rule of the czar to the dictatorship of the proletariat.

His chief works are 'Sebastopol' (1855); 'War and Peace' (1864); 'Anna Karénina' (1875); 'My Confession' (1882); 'The Kingdom of God Is Within You' (1892); 'Resurrection' (1899).

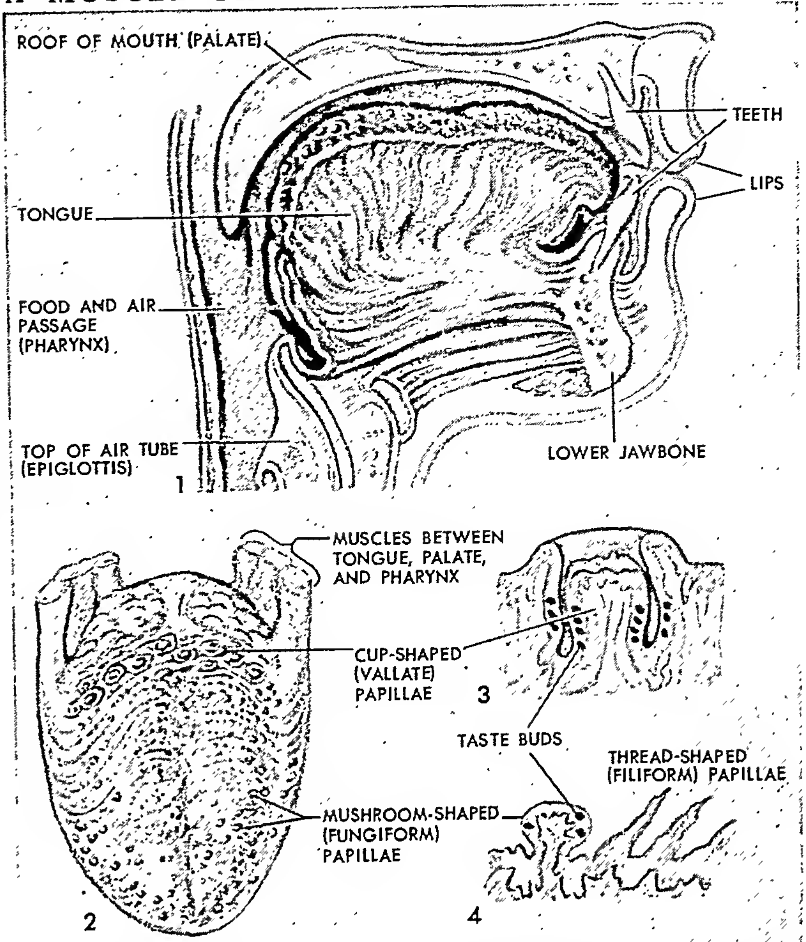
TOMATO. In the old-fashioned gardens of our great-grandmothers there grew a bushy sprawling plant with brilliant scarlet pulpy fruit, much wrinkled and distinctly smaller than the tomatoes of today. These were called "love-apples," and if you had suggested eating one your great-grandmother would have held up her hands in horror; for the plant belongs to the same family as the deadly nightshade and it, too, was thought to be poisonous. It was not until well into the 19th century that this idea was proved false, and tomatoes began to be cultivated for their agreeable, slightly acid fruit.

Today the tomato is one of our favorite foods. It is a welcome ingredient in soups, may appear in any one of a dozen ways as a vegetable, is an almost indispensable ingredient in a meat relish, makes a tart green pickle, and is at its best in salad. Tangy flavor and richness in vitamins A and C make canned tomatoes and tomato juice popular.

Tomatoes are now cultivated in all temperate regions of the world, and they are canned in greater quantities than any other vegetable. They are also the basis of tomato catsup (or ketchup), chili sauce, and other relishes. A century of cultivation has produced a large, smooth, thin-skinned, fleshy fruit, instead of the small seedy specimens of the old gardens. In some varieties a single tomato may weigh two or three pounds. Some large varieties are yellow when ripe, but these do not ship well and are now rarely grown commercially.

The tomato plant, like the potato, was originally found in South America. It is a bushy annual grown from seed. The plant has jagged leaves and small yellow bell-like flowers. The tender branches cannot support the modern heavy fruit and require staking. Oil pressed from tomato seeds is used in Italy for making soap. The scientific name of the tomato is *Lycopersicum esculentum*.

A MUSCLE THAT HELPS US EAT AND TALK



1. This picture shows the inside of the mouth and throat as it would look if cut down through the middle. Note the large muscle forming the tongue and the bumpy appearance of the mucous membrane which covers it. 2. Here is the tongue as seen from above. The fungiform papillae are exaggerated to show their location. 3. and 4. These magnified cross sections show the three types of papillae.

TONGUE. The tongue is one of man's most important muscles. It helps him to choose food by taste and to chew and swallow food. It helps him talk clearly.

The tongue lies on the floor of the mouth. At the bottom and the back it is attached to other structures of the throat and mouth. The front part is free and can move in many directions. The tongue is a voluntary muscle and can therefore be moved at will.

A mucous membrane (*mucosa*) covers the tongue. This membrane contains tiny bumps, or *papillae*, of three different kinds, as shown in the accompanying picture. Cup-shaped (*vallate*) and mushroom-shaped (*fungiform*) papillae contain taste buds. These are sense organs of taste in the form of tiny projections which react to chemicals in moistened food and start nerve impulses of taste toward the brain. (*See also* Taste; Sensation.) Thread-shaped (*filiform*) papillae are scattered thickly over the front two thirds of the tongue and make the surface rough. The entire mucous membrane of the tongue reacts to heat and cold, roughness and smoothness.

The tongue pushes food around during the act of chewing and helps moisten it with saliva. In swallowing, the tongue contracts and pushes food backward down the pharynx, thus starting the food toward the stomach. Because of these functions, the tongue is part of the digestive apparatus. It is also an organ of speech. By touching or not touching the teeth and the roof of the mouth, it helps in the formation of sounds. A person who is tongue-tied cannot talk plainly because his tongue, held down by abnormal shortness of the fold of mucous membrane underneath it, cannot move freely.

In health the tongue is moist and pink, with a velvety look. In sickness it may have a yellow coating, become brilliant red, or show white patches, according to the type of disease.

True tongues appear only in animals with backbones. In the course of evolution they developed from a part of the breathing apparatus of fish. Thus fish have no tongue or else a very simple one. Amphibians have long powerful tongues with which to catch insects and other food (*see* Frog; Toad). Some lizards have broad plump tongues to help them eat. Others have forked tubular tongues which they use to feel their way about. The forked tongues of snakes are sensitive organs of touch. The tongues of mammals are more like those of man. In meat eaters such as the cat, the filiform papillae, which are the smallest papillae in the human tongue, are well developed and horny (*see* Cat).

TOOLS—*The* BUILDERS *of* CIVILIZATION

How Men Have Taken Lifeless Stone and Wood and Metal and Put Them to Work—Giant Devices that Pound and Stamp and Bore and Cut and Shave—The Ingenious Labors of the Lathe Family

TOOLS. Man's answer to tasks beyond the power of his body, in the working, shaping, and moving of materials, was the invention of tools. With them he multiplied his power, and supplemented the work of his hands and feet. Of all the creatures, man alone is a user of tools. The first tools were of the simplest nature, being instruments for striking, for cutting, for shaping, for holding, and for moving things. But man had always possessed these in his body itself, for the fists and feet were his striking tools, his nails and teeth served him for cutting, the hands could grasp things and shape them, while arms, legs, and jaws could furnish power and leverage to enable him to perform certain tasks.

LABORIOUSLY SLOW WORK WITH PRIMITIVE TOOLS

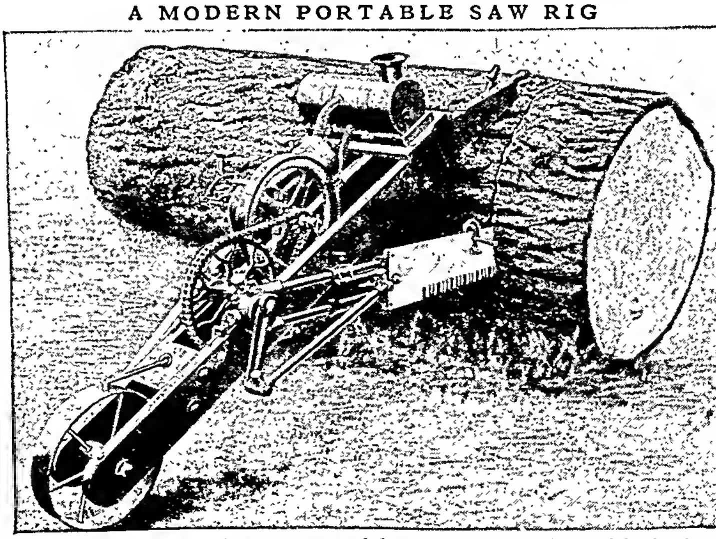
This patient Japanese wood sawer will work all day long to cut this great log apart, and then he will have to cut it again and again to make planks of it. His ax, lying on the tree trunk, and the saw are not as primitive as many still in use today.

The first man who thought to crack a nut with a stone, utilized the first tool of the hammer type. A later genius tied a handle to it and made the first hammer, which has come down to us in so many adaptations. Whoever found that a shell or sharp stone would cut invented the first knife, ancestor of the great family of cutting tools. The first leverage tool was probably only a stick, used perhaps to pry up a stone, but it has been succeeded by many others. We shall never know who first scraped mud with a stick, or a stone, or a shell, but at that moment the first shaping tool came into existence. And holding tools had their primitive counterpart when some flint worker thought of wedging his material between two stones or in a cleft stick. Today, all our tools may be so classified; even the most complicated may be seen to be adaptations and improvements, or combinations of these five principal divisions of tools.

Striking or Percussion Tools

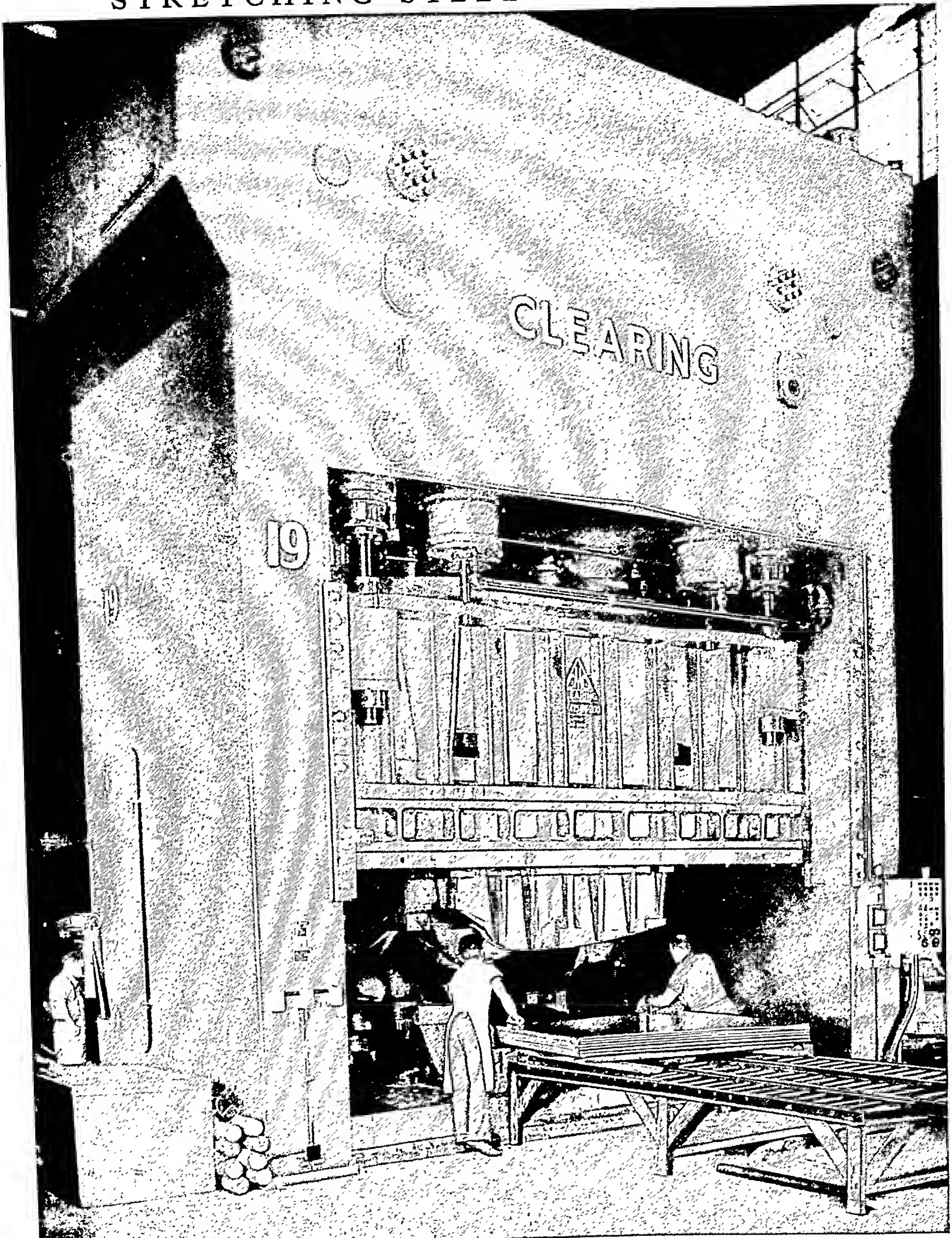
The hammer is the simplest of tools, and has undergone little change, in most respects, from its primitive form. It is, after all, just a weighted head, whether that be a stone or a thousand-pound casting, and something to direct its course, which may be a lashed-on stick, or the channels of a great drop-forging hammer. It was important to early man, for with it he killed beasts for food, defended himself, and later fashioned yet other tools. The striker of blows, the smiter, the smith came to be a personage. On his crude anvil the swords and shields, the pots and pans, the armbands and necklets took shape under his hammer. Later came specialists in his trade, each with his own special tools—the armorer and gunsmith, the coppersmith and ironsmith, the goldsmith and silversmith.

A MODERN PORTABLE SAW RIG



Compare this cross-cut saw, operated by a gasoline engine, with the hand method of sawing shown above. It will make from 100 to 200 strokes per minute, and the saw will be driven through timber at the rate of a foot or more a minute.

Today we have many kinds of hammers, from the common sledge, with its two faces for striking, to the claw hammer, which is a combination of a percussion tool with a lever and a holding device. In many trades combination hammers are used, one face



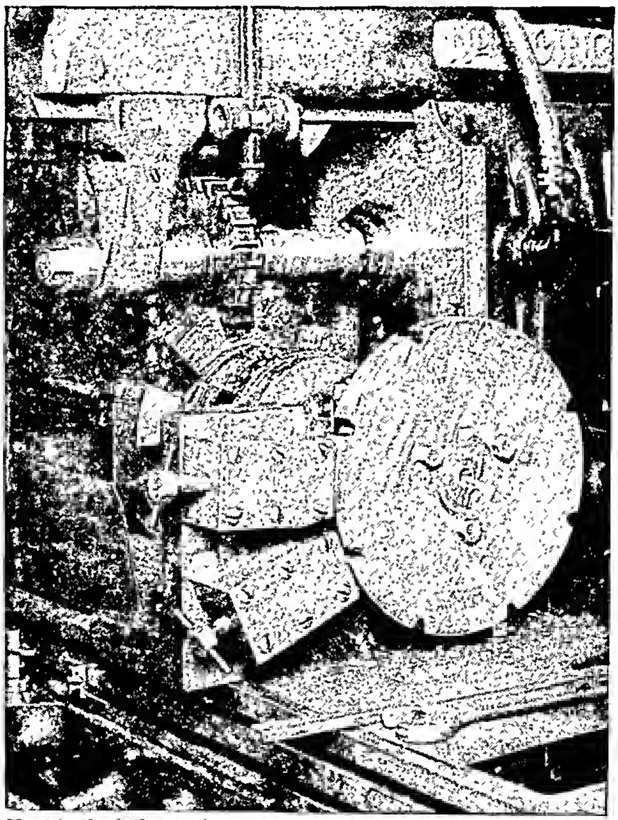
With a sharp thud this huge body press smashes a flat steel sheet into an automobile hood. The great hydraulic machine is one of the biggest among many varieties of punch presses. In these presses sheet metal is laid or held on a specially shaped die while a punch drops on it with great force. Some punch presses are used for *drawing,* as shown here. In this process the impact of punch and die pushes and stretches the metal into shape. Less powerful presses are used for *blanking* (cutting to outline) and for *forming* (bending to shape).

for striking, and the other for shaping. Other hammers have one cutting or punching face.

There are also remarkable developments of the hammer. The rat-tat-tat of the pneumatic riveter is the sound of the hammer, driven at high speed by compressed air. Rock drills and pavement breakers are of the same type. Then there are huge mechanical hammers, operated by steam or electricity, which perform operations no smith could hope to do. The steam hammer was devised by an engine builder, James Nasmyth, who invented it to forge the crankshaft of an engine—to be the biggest then known, to go into the largest vessel of its time. The problem of forging such a crankshaft seemed insurmountable, owing to its size; so Nasmyth used steam to lift a heavy block of iron, faced with steel, which dropped, guided by channels, onto the work, exerting more effort than a thousand men could apply with hammers.

Drop forging, as this process is called, is now used for many operations, the forging of crankshafts for automobiles and other engines, and for the production of many other parts. Pile drivers are mechanical hammers, sinking long heavy piles deep into hard earth in a few minutes, where it would take hours for men to do the job with heavy mauls. The skull-cracker, breaking up scrap iron in the foundry yard, is a hammer, its tremendously heavy ball being lifted by electric magnets, and then released to shatter the iron below into pieces suitable for the furnace.

CUTTING OUT GREAT STEEL TEETH



Next to the lathe, perhaps the milling machine is the most important machine tool. In this picture the milling cutter on the upper shaft, or "arbor," is cutting slots in the heavy piece of steel below it. The slots are accurately spaced by means of the "index plate" in the foreground, which is connected to the work. Such machines work to thousandths of an inch.

Leverage Tools

The simplest of the lever tools is the common crowbar, sometimes made with one end bent slightly, so that in effect it supplies its own fulcrum. Car movers are large tools of this simple type. A screwdriver is a lever tool, although the connection may not at first be clear. But widen the handle into a T and the lever principle is obvious. The brace, to hold a bit, is a form of the lever known as a crank, and so is its improvement, the breast drill and other similar tools, operated by a crank and gears. Both are combinations usually, as they are fitted with a holding device called a chuck, in which the bits are inserted. The wrenches, whether the common wrench, the pipe wrench, the spanner, or the many kinds of socket and end wrenches, are lever tools, also with a holding device. Other lever tools are combinations with cutting tools, such as scissors, and metal shears that require leverage to do their work.

Holding Tools

Holding tools are of fairly simple character, although we have vises in many forms, adapted to various sorts of work, and more complicated developments like a lathe chuck. Pincers and tongs are holding tools, often in combination with cutting edges as in pliers, which are also used for shaping. Forceps and tweezers are similar. Many tools of the more complicated kind are simple tools in highly adaptable holders, such as the plane.

Shaping Tools

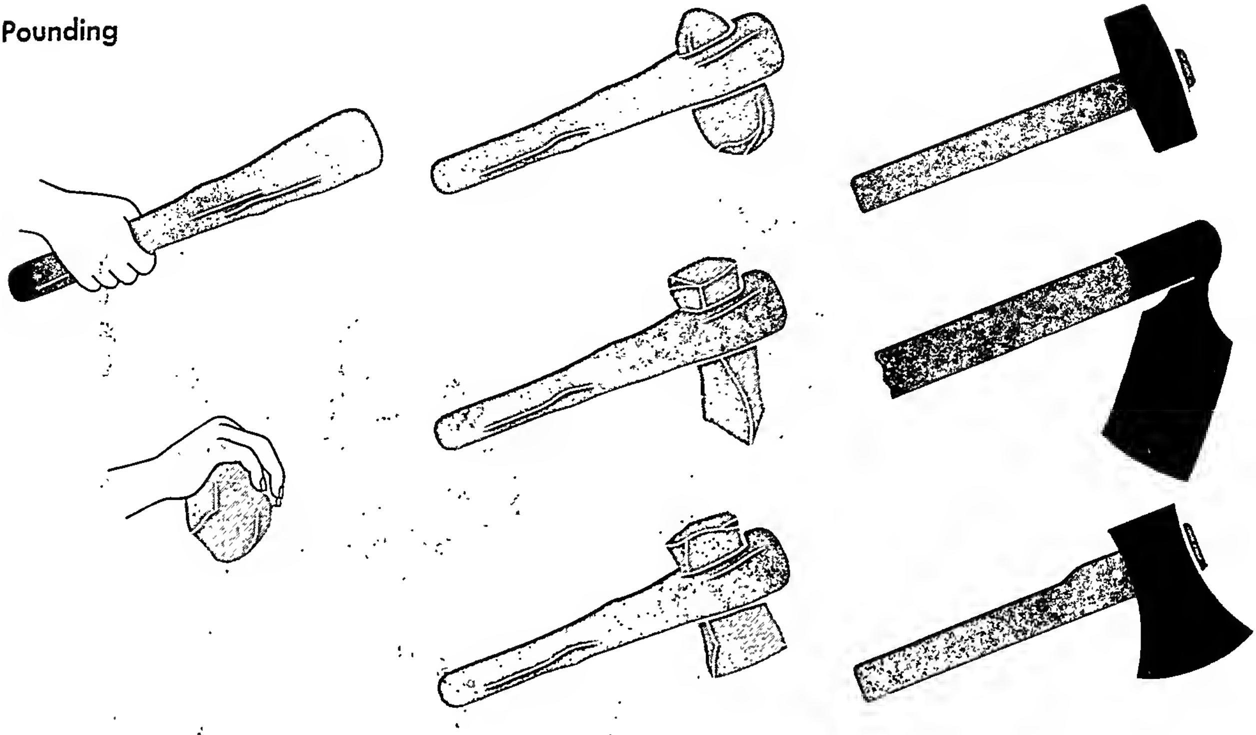
The trowel, whether the mason's pointed trowel, or the plasterer's rectangular trowel, the tuckpointer's smaller instruments and the putty knife, are shaping tools of the simpler sort. Paint brushes belong in this category, for there is little difference between smoothing a coat of cement or plaster and applying one of enamel. The blacksmith's anvil is a shaper; and there are bending machines for wire work, to handle sheet metal; forming tools of every description, mandrels, knurls, screw-rolling dies, rivet sets, and others, from small punches used by jewelers to gigantic power presses that squeeze metal into shaping dies with a pressure of thousands of pounds.

The Great Family of Cutting Tools

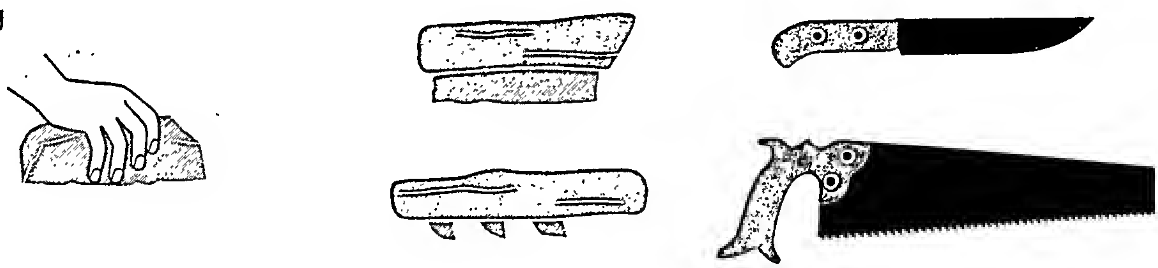
Cutting tools, and their countless variations, form the largest division of the tools man has devised, for in working materials to usable size and shape cutting, trimming, and fitting are of the greatest importance. The first cutting tool was a crude knife, and for hundreds of years men used shells, stones, and even splintered and hardened wood. Weapons came first, then domestic tools, then tools for primitive farming, such as crude hoes, shovels, and plows. With the discovery of metal, and a means to work it, men

How Modern Tools Grew Out of Primitive Devices

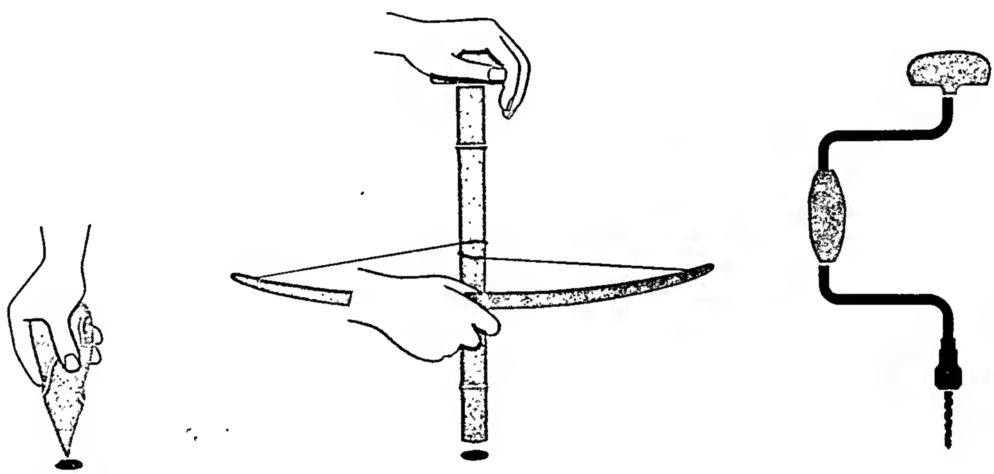
Pounding



Cutting



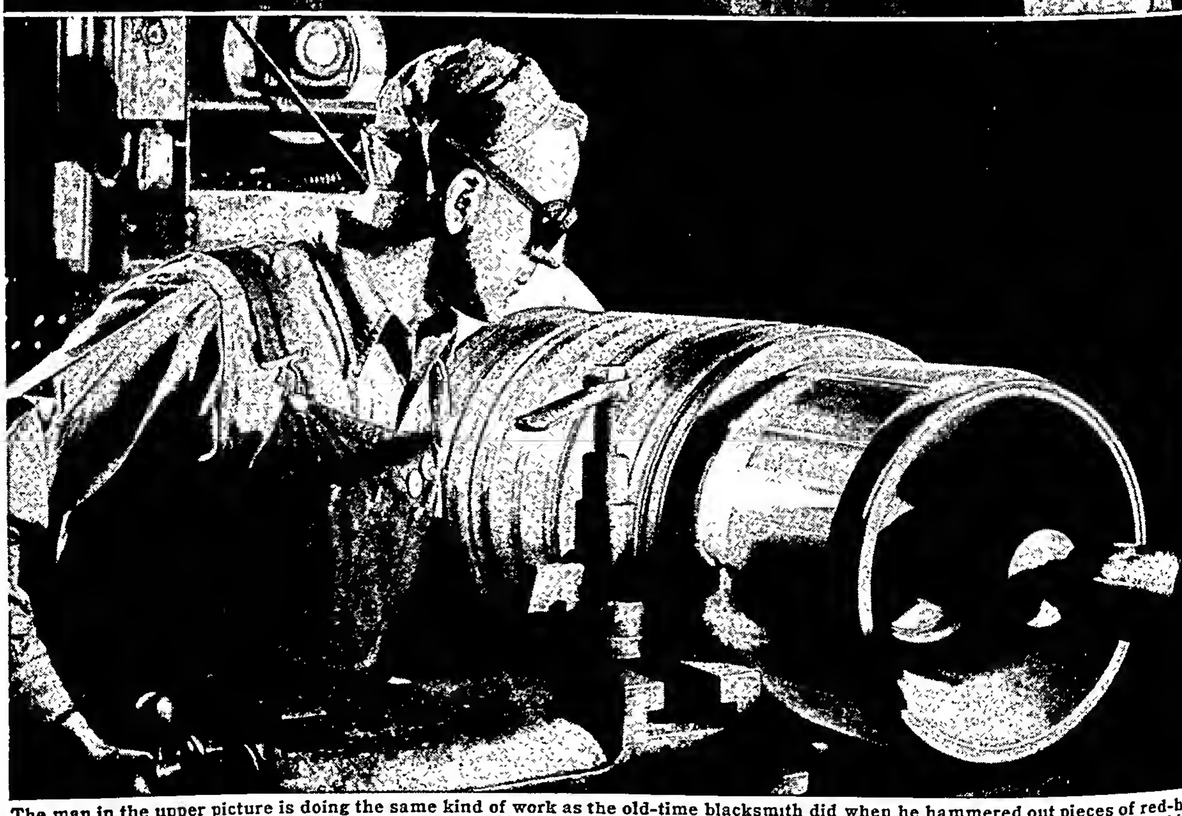
Boring



brown: wood gray: stone black: steel

Prepared for Compton's Pictured Encyclopedia

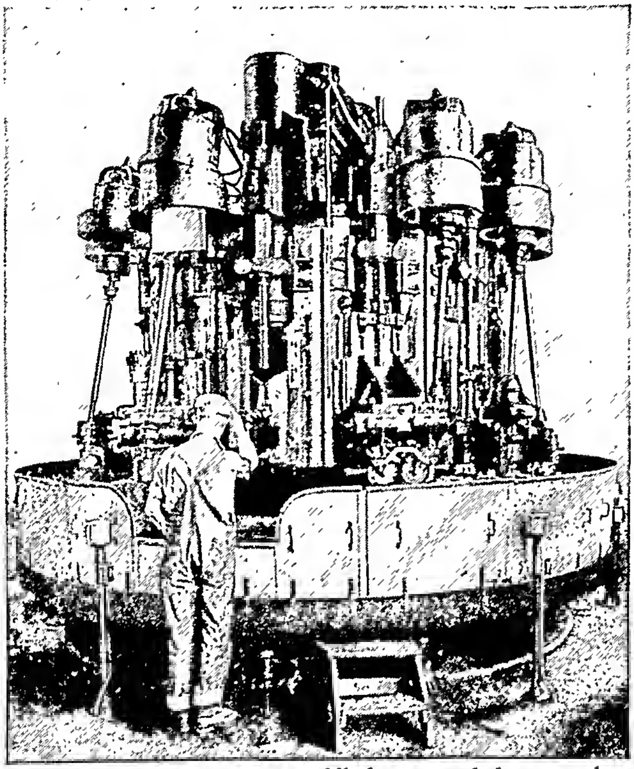
HAMMERING AND CHISELING BY MACHINERY



The man in the upper picture is doing the same kind of work as the old-time blacksmith did when he hammered out pieces of red-hot iron on his anvil. But he is using a hammer that weighs several tons and so has to be lifted and dropped by high-powered machinery. The resemblance between hand-chiseling and lathe work, shown in the lower picture, is not so clearly evident. For, instead of the machine's driving the tool against the work, the tool is stationary and the work revolves against the tool's cutting edge.

began really to develop this powerful tool. The crude stone ax, an early tool that probably followed the hammer, gave way to an efficient sharp-edged implement. Knives and chisels could be made in a multitude of shapes, and the bad knife, which man had found made a good saw, could now be made with teeth set at regular intervals. As time went on, cutting tools were made for countless purposes, so many that it would be impossible to list them all. They fall into several easily distinguishable classes at the present time. There are sharp-edged tools for cutting and shaving, tools of the saw variety, with serrated edges, tools that cut by abrading or grinding, and certain tools of the punch type.

A HIGHLY SPECIALIZED MACHINE TOOL



All the spring hangers on automobile frames made by one maker are "machined" completely on this complicated automatic device. Such a machine tool is almost a complete shop in itself.

Edged Tools

The commonest of the edged tools are also the oldest: the chisels, knives, planes, augers and bits, reamers and countersinks, thread-cutting dies, axes, hatchets, scissors and shears, and hundreds of others. Some of the edged tools, like saws, are composed of many small cutting edges, but act to tear rather than slice the material. Files and rasps are of this type, while grinders that utilize the scratching or abrading properties of certain substances like minerals are quite similar, as a still greater number of fine cutting surfaces are presented to the work. Originally used for finishing edges, the grinder has become of paramount importance in machine work, and is standard equipment used in a great variety of operations involving high accuracy. Punches are of many kinds, and are frequently used for making holes of various shapes in place of the longer operation of boring.

Mechanical Principles in Tools

Simple tools satisfied the needs of workers for many years, but as wants increased and experience grew, developments of far-reaching importance were made. Men discovered certain mechanical principles (*see* Mechanics), and with them the means to make work more effective. Some of these applications of mechanical principles are not tools, in the strictest sense of the word, but they served to make tools more powerful. The crank, the wedge, and the wheel were applied to tools, with amazing results. From the wheel developed the pulley and block, and the windlass, and most important of all—the lathe.

The potters' wheel is one of the oldest of wheeled tools, for no one knows when or where it was invented. But when man discovered how circular motion could be made to work for him, he made the first start toward the great tools of today. This primitive potters' wheel was the first lathe, and for many years men shaped vessels of clay upon it. Then some genius thought to shape wood with it, holding a sharpened cutter or chisel against the revolving piece of wood. Later it was used for turning metal.

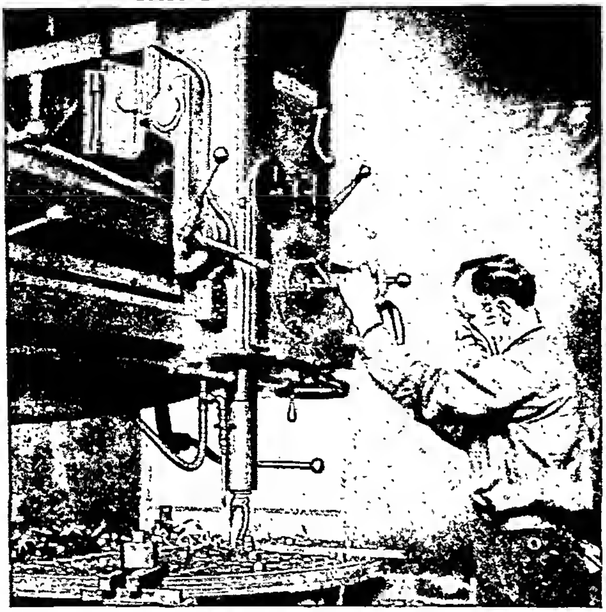
But no great progress was made until about 1800, when Henry Maudsley, the first great toolmaker, took the crude metal-working lathe of his day and added to it the slide rest and an automatic screw-cutting attachment. This may be termed one of the great inventions leading to the industrial age, for with his inventions man was able to obtain accuracy and maintain standards in the working of metal parts. Up to that time there was no such thing as a standard thread, nuts were not interchangeable as now. Engine cylinders, crude affairs with sheet-iron cylinders and hammered pistons with sometimes as much as three-fourths of an inch clearance, could now be cast in the foundries and accurately bored and finished. The immediate improvement in the engine was marked, and the application of its power to industry increased the demand for more machines, which meant more tools, and better ones.

Standard Machine Tools

The machine shop of today has a number of standard tools, besides many special ones. The lathe, the drill press, the shaper, the planer, the milling machine, the grinding machine, and the boring mill, are usually considered standard. The special ones are all modifications of the standard machines and their operation can be understood easily.

The lathe is simple in principle: the material to be worked is rotated, and a cutting tool, usually fixed in a movable holder, is "fed" against it, removing a chip or shaving of the metal, keeping it to a circular form. *Longitudinal feed* is parallel to the axis of the work; *cross feed* is at right angles to it; the first producing *straight turning;* the latter, *facing* or *squaring.* Tapers are cut at an angle to the axis. Threads may be cut on the

RADIAL DRILL PRESS



The drill of this press gnaws two-inch holes through eight thicknesses of steel plate. The position of the drill can be changed, and the steel plates need not be moved on the bed.

work by means of *change gears* which drive the longitudinal feed. These can be shifted much as automobile gears are shifted. This gives a wide range of speeds and hence of thread sizes.

The drill press is used for cutting holes in metal. The work is held firmly on the bed of the machine and a power-driven drill is fed into it.

The shaper is used for cutting small flat surfaces. The work is held on a bed while the tool moves back and forth over it. The square-faced tool is held in a hinged *clapper box*. This arrangement permits the tool to dig into the metal on the forward stroke and swing free on the return stroke. The bed edges over slightly after each cutting stroke, bringing a fresh surface under the tool. The planer is used for cutting extensive flat surfaces. In this very large machine the work is held on a sliding table which moves back and forth on a long bed. Over the bed and table is an archlike structure holding the tool in a clapper box. The tool mounting moves sidewards a little after each cutting stroke of the table.

In the milling machine a toothed cutter revolves against the work, removing metal with its sharp edges. Cutters are made in many shapes and sizes.

The grinding machine (usually called grinder) uses an abrasive wheel to obtain accurate and fine finishes on metal parts. Three types are in general use—cylindrical, bore, and surface grinders.

Many Tools for Special Purposes

To turn out a number of pieces exactly alike, *production machines* are used. The turret lathe, for example, permits the operator to use several tools and to perform a series of operations on the work without changing his setup. The automatic screw machine is somewhat similar but is so fully automatic that one operator can tend several machines. The multiple drill press cuts a number of holes in a piece simultaneously. Tapping machines cut threads in drilled holes automatically. Punch presses of all sizes are used where large numbers of identical pieces are to be blanked, perforated, or formed.

Many measuring devices (in the shop called "small tools") are also in use. Some instruments for laying out work and gauging it, such as the square, the plumb, and the level, have been used since ancient times. More modern is the micrometer (micrometer caliper). It is used more than any other measuring device in the machine shop (*see* Micrometer).

TOPEKA, KAN. A literal translation of the Kaw Indian word "Topeka" is "good place to dig potatoes." Only the operators of a ferry, one of whom was an ancestor of Charles Curtis (vice-president under Herbert Hoover), were at the site on the Kansas (Kaw) River in 1854 when Cyrus K. Holliday selected it as a main point on his projected railroad (now the Atchison, Topeka and Santa Fe Railway). The settlement grew quickly; it became the temporary territorial capital and then, in 1861 when Kansas became the 34th state, the permanent state capital.

Topeka is a focal point for a considerable amount of farm trade, the headquarters for a number of large insurance companies, and a meat-packing and processing center. Its printing and publishing and rubber tire industries are also important. The city has the Santa Fe's main offices and rail car and engine repair shops. State institutions in or near the city include a large hospital for the insane and two correctional schools.

Topeka is located in northeastern Kansas. It occupies both banks of the Kansas River and spreads north and south into low hills. Its pleasant, wide streets are shaded by rows of elm, hackberry, walnut, and maple trees. Gage Park, in the western part of the city, has more than 140 acres; in it are an old settler's log cabin, the Renisch Rose Gardens, and several athletic fields. On Washburn University's elm-shaded 160-acre campus is the Mulvane Art Institute. The Capitol, with four wings in the form of a Greek cross and a 304-foot dome, is modeled after the national Capitol. Also of interest are the former home of Charles Curtis, the four-story white marble Memorial Building, the Menninger Foundation—famed for its work in psychiatry—and a Veterans' Administration hospital.

The Kansas River has often flooded the lower parts of the city; a very damaging flood occurred in 1951. The city has the commission form of government. (*See also* Kansas.) Population (1950 census), 78,791.

TORONTO, ONTARIO. The Huron Indian word Toronto means the "meeting place" or "carrying place." Today Canada's largest city rises where ancient forest trails converged on the northern shore of Lake Ontario. It is the capital of the province of Ontario and ranks next to Montreal in industry.

Within a radius of 100 miles of Toronto is concentrated one third of Canada's buying power. To serve this rich market the city's manufacturing in-

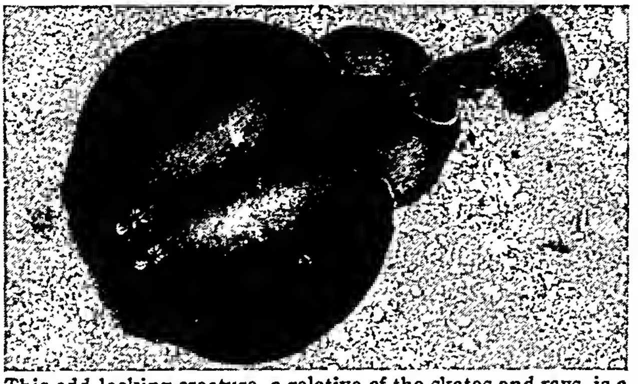
dustries have grown with giant strides. Lake freighters bring iron ore from the mines of Minnesota and western Ontario, grain from the prairies, coal from Ohio and Pennsylvania. They come through the Welland Ship Canal directly to the city's mills and factories. The steel trails of the railroads bring in other raw materials from the rich farms of the Niagara peninsula to the south, and the forests and mines of the Laurentian Plateau to the north. Cheap hydroelectric power is available from Niagara Falls and the Gatineau River power plants. By rail, water, and air the finished products are distributed to all sections of the country. These products include airplanes, automobiles, tires, electrical apparatus, brass, copper, aluminum, and sheet metal goods, canned fruits and vegetables, meats, flour, and wood products. Many United States firms have established branch factories in Toronto. This is the printing and publishing capital of the country, and it claims the world's largest mining exchange.

The city lies on a plateau which rises gradually from the lake to an altitude of about 300 feet. Two rivers, the Don and the Humber, and many wooded ravines give the residential areas unusual natural beauty. The city's 10-mile water front has been extended out into Lake Ontario to provide new land for industrial sites, railroad switch yards, warehouses, and docks. The west end of the harbor is devoted to recreational facilities. On the lake front, also, are the grounds and permanent buildings of the annual Canadian National Exhibition. A four-and-a-half-mile subway was started in 1949 to remove all streetcars from the main business arteries.

Yonge Street extends from the water front to the northern city limits. In Queen's Park stand the Parliament buildings and the University of Toronto. The university, one of the British Empire's largest, was chartered in 1827 as King's College. Here Dr. F. G. Banting discovered insulin. Cultural centers include the Royal Ontario Museum and the Art Gallery.

Toronto's history dates from the building of Fort Rouillé by the French in 1749. In 1793 the English burned the fort. The next year John Graves Simcoe, lieutenant governor of Upper Canada, chose the site as his capital. He named it York for the Duke of York. In the War of 1812 American forces occupied it and burned some buildings. In 1834 it was incorporated and the Indian name was restored. Its population in the 1951 census was 675,754. In 1953, however, the Ontario legislature united Toronto and its suburbs into a federation, making it the largest city in Canada, with a population of 1,117,470.

THE FISH WITH ELECTRIC BATTERIES



This odd-looking creature, a relative of the skates and rays, is a torpedo fish. Its round flat body lies on sandy bottoms. The electric storage cells are on each side of its body near the head.

TORPEDO FISH. All creatures are provided with some means of defending themselves. The fishes usually appear to be helpless, yet some have defenses which are very unpleasant to man. The torpedo fish is a living electric battery. Many swimmers and ocean fishermen have received paralyzing shocks from this fish. The torpedo fish belongs to the family of skates and rays. Near the head on each side of its big circular body is a system of electric storage cells. These cells consist of a group of prism-shaped compartments of muscular fiber, running perpendicularly through the body of the fish. The upper side of the torpedo is the positive pole of the battery and the lower side is the negative pole.

When it is out of water, the torpedo must be touched at two distinct points before the circuit is complete and the shock received. But in the water, which is an excellent conductor of electricity, only one point of contact is necessary. Swimmers in southern waters occasionally strike one of these creatures with their feet, and many mysterious cases of drowning are attributed to the crippling effect of these electric shocks.

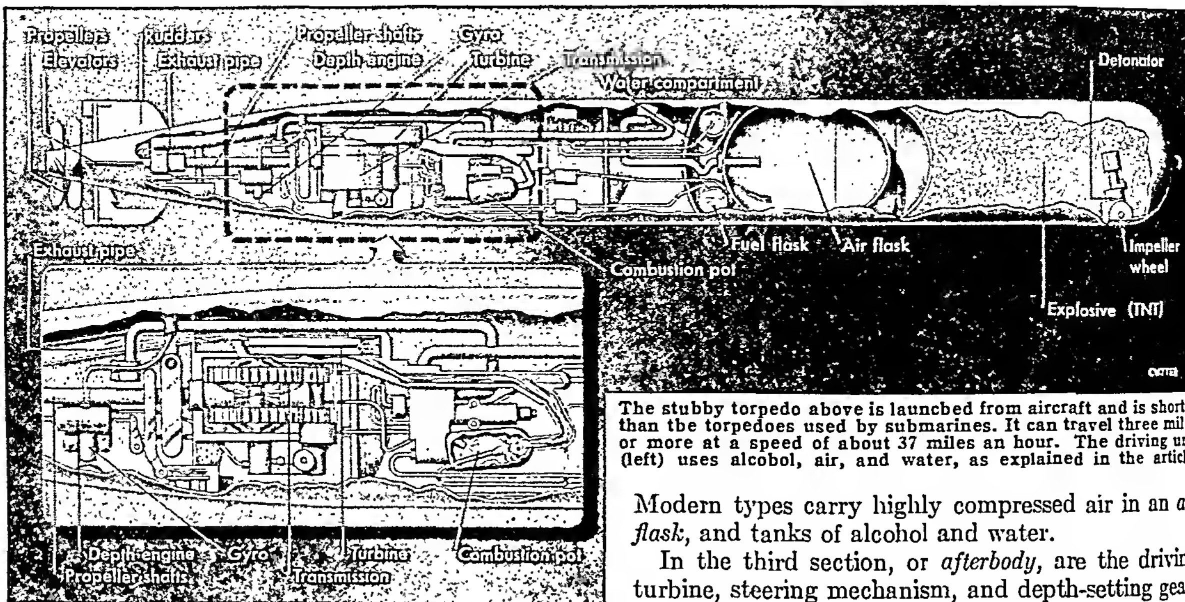
The "shocking" apparatus is not only used by the torpedo fish to defend itself but to stun and kill the smaller animals on which it feeds. Repeated use of the organs exhausts the fish, and a period of rest is necessary. When the fish is sick or dying, its electric powers gradually disappear.

The torpedo fish is round and flat, with a stout tapering tail to which the fins are attached. Its body is smooth and soft to the touch. The largest species is found on the Atlantic coast from Cape Cod south, some of them reaching four feet in length and weighing nearly 200 pounds. On the Pacific coast is another species, found from Vancouver Island to San Diego Bay. It is also known as the crampfish.

Several other kinds of fishes, notably the electric eel of South American rivers, have the same strange ability to generate electricity. The electric eel is not an eel but a relative of the carp and catfish. Its electric organs are located in the tail. The fish can discharge enough electricity to kill an animal of considerable size, and it is said to possess enough power to knock down and benumb a man.

The electric catfish is a fresh-water fish of Africa. Its shock organs are scattered through a sheath of gelatinlike material that covers the entire body. The current passes from the tail to the head. It does not give as strong a shock as the torpedo fish or the eel. The marine stargazers have electric organs immediately behind the eyes.

THE DEADLY TORPEDO IS A COMPLEX MACHINE



The stubby torpedo above is launched from aircraft and is shorter than the torpedoes used by submarines. It can travel three miles or more at a speed of about 37 miles an hour. The driving unit (left) uses alcohol, air, and water, as explained in the article.

The scientific name of the torpedo fish is *Tetranarce occidentalis;* of the Pacific torpedo fish, *Tetranarce californica;* of the electric eel, *Electrophorus electricus;* of the electric catfish, *Malopterurus electricus;* of the stargazer, *Astroscopus guttatus.*

Torpedoes and Mines. Among the most effective weapons of naval warfare are torpedoes and mines. A torpedo drives itself toward its target. A mine lies in wait for a ship to strike it. Otherwise these two powerful weapons are alike in principle and purpose.

Men experimented with crude torpedoes and mines as early as 1585. But it was not until the Civil War in America that they were put to effective use. The Confederacy, in particular, realized their value for blockading channels and destroying ships.

The name "torpedo" was used for both kinds of weapons until after the Civil War. "Spar torpedoes" were attached to long poles, or spars, and thrust against enemy craft from small boats. The first self-propelled torpedo was perfected in 1864, when Robert Whitehead, a Scottish engineer, developed an idea given him by Captain Luppis of the Austrian navy.

How the Torpedo Does Its Deadly Work

The navies of the world came to use modifications of the Whitehead torpedo almost exclusively. The cylindrical case or shell can be from 18 to 24 inches in diameter and from 16 to 22 feet long. Those used by United States submarines in the second World War had a standard diameter of 21 inches and were about 20 feet long.

Inside this long case are three sections. Just behind the detonator, set in the nose, lies the *warhead,* containing about 400 pounds of high explosive. A firing pin on the nose is automatically unlocked as the torpedo is launched. If the firing pin strikes an object, the detonator sets off the charge. The second section contains the materials for driving the torpedo. Modern types carry highly compressed air in an *air flask,* and tanks of alcohol and water.

In the third section, or *afterbody,* are the driving turbine, steering mechanism, and depth-setting gear. The turbine is powered by steam generated by an alcohol air blast flame. The turbine drives two concentric propellers which revolve in opposite directions. A gyroscopic steering mechanism controls a vertical rudder which keeps the torpedo on course. A depth engine moves horizontal fins and makes the torpedo stay at constant depth.

A torpedo can travel at a speed of 50 miles an hour for a distance of five miles or better with little difficulty. It is most effective at close range. Its chief disadvantage is the trail of bubbles, or wake, from the steam or compressed air. This can reveal its approach to a ship, which might have time to dodge.

To overcome this, the United States Navy developed an electric-drive torpedo, powered by high-capacity storage batteries. This can strike without warning and without revealing the location of the attacker. Germany had also perfected a similar "wakeless" torpedo during the second World War.

Guiding and Detonating Devices

The second World War saw the development of other new types of torpedoes. One type is controlled by radio. Another *acoustic* type is steered toward an enemy ship by vibrations from the ship's propellers. One type of detonator reacts to the magnetic field around a metal ship, setting off the charge. This torpedo can travel deep in the water to explode under the vulnerable keel of a ship.

Submarines, destroyers, motor torpedo boats, and other ships launch torpedoes from tubes, using compressed air or a charge of explosive (*see* Navy). Torpedo airplanes drop them horizontally from a low altitude (*see* Airplane). The torpedo shown above may be dropped from heights of 500 feet or more. When dropped, its engine starts and the firing pin unlocks as in other types.

If a torpedo misses its mark, it sinks. Otherwise it would act as a floating mine. During practise, however, it is set to come to rest on the surface

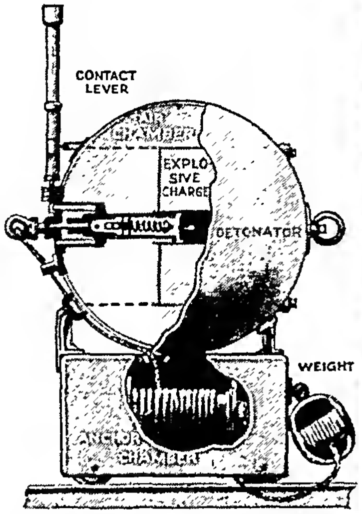
and it is automatically made safe again.

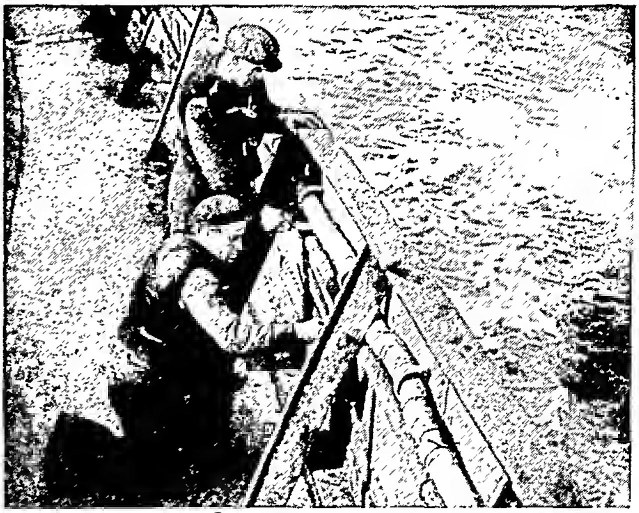
Underwater Mines

A modern mine for use under water is a cylindrical or spherical steel case, about a yard in diameter. The case holds 300 pounds or more of explosive and enough air to make the mine buoyant. It is held a few feet below the surface by a cable and a heavy weight which lies on the bottom.

If the mine is of the *controlled* type, it is fired electrically through wires from a shore station, when an enemy ship passes over it. A *contact* mine explodes when a ship strikes it. One simple type has a lever which moves when hit and fires the mine. Another type has projecting horns which release acid when they are struck. The acid fires the charge.

A CONTACT MINE AND A SHIELD AGAINST MAGNETIC MINES





The mine at the left explodes if a ship strikes the lever. It is resting on its anchor ready for laying. The whole apparatus sinks to the bottom, where the impact releases the mine from the anchor. The mine floats up unreeling the mooring cable to a predetermined length, usually just enough to hold the mine a few feet below the surface. At the right, two seamen inspect a "degaussing" cable that surrounds their steel ship and protects it from magnetic mines.

An *antenna* mine has one or more copper wires trailing above it. When a steel ship hits a wire, it sets up an electric current that explodes the mine. During the first World War, the American and British navies confined German submarines within the North Sea with a barrage of more than 70,000 antenna mines laid in an area 230 miles long and 30 miles wide.

The *magnetic* mine is fired by electromagnetic force when a metal ship approaches. In one type, a control needle lies motionless between two electromagnets until a passing ship upsets the magnetic balance. The needle swings and closes a contact which fires the mine. An *acoustic* mine is set off by a change in the noise level surrounding the mine. A small carbon microphone picks up the noise of a near-by ship's propellers and this starts the firing reaction. These mines are *ground* mines, which lie in wait on the ocean bottom.

Protection Against Sea Mines

Ships can be protected from anchored mines with the *paravane*, an invention of the first World War. It consists of a cable 150 feet or more long and two cigar-shaped steel "otters." The middle of the cable is fastened to the bow of the ship, to tow one otter on each side. Whenever a mine mooring is encountered, it is forced into cutting knives on the nose of one of the otters. The knives cut the mooring line and the mine rises to the surface. There it can be destroyed by gunfire. Magnetic mines are made ineffective by maintaining an electric current in a cable or magnetic girdle around a ship. This neutralizes (degausses) the magnetic properties of the ship.

A MISTAKE MEANS DEATH!

These soldiers are seeking buried land mines with an electrical detector at risk of their lives. Whenever the detector passes over the metal of a mine, it gives a warning buzz.

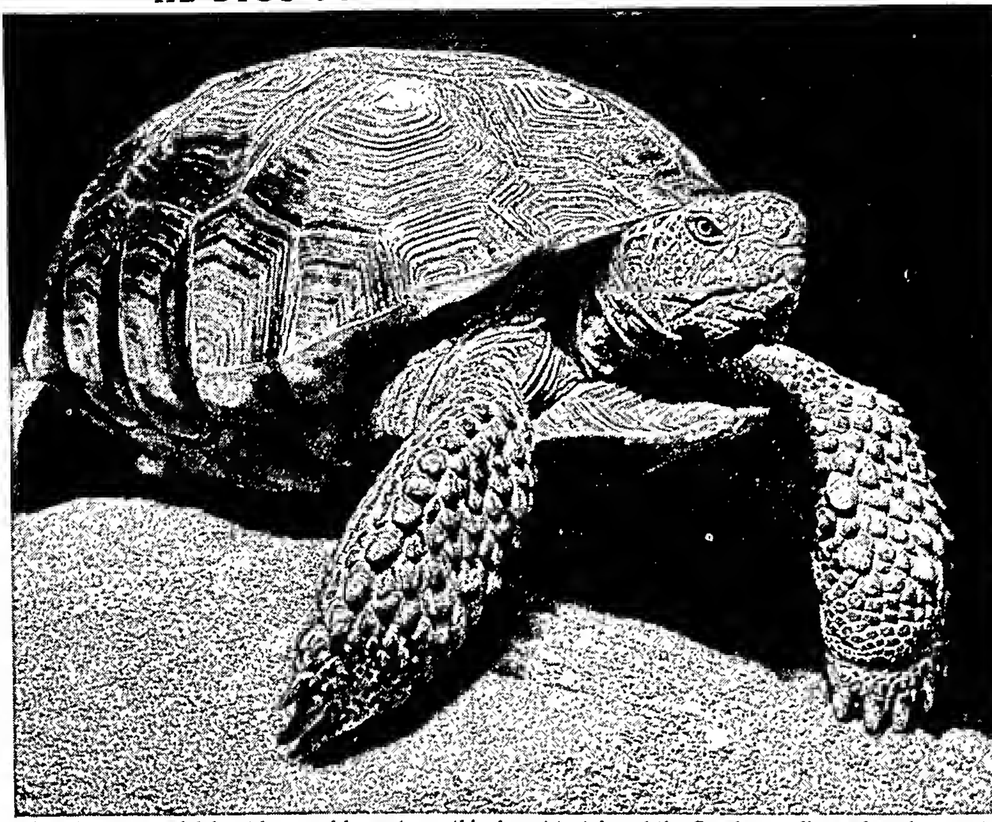
Anchored mines may be removed from the water by mine sweepers. These ships may use paravanes; or two sweepers may steam abreast a few hundred feet apart, dragging a slack, heavily weighted cable between them. The cable catches the mooring lines of the mines and drags the mines themselves to the surface. Another method is *countermining*—that is, firing heavy charges of explosive in the area. The shocks set off the mines.

Land Mines

Land mines came into use with gunpowder itself. Besiegers of a castle or town often dug a tunnel and packed it with powder to blow up a gate or a wall. Today land mines usually are buried along roadsides, or over wide areas to form *mine fields*. They have contact fuses which explode when a tank or truck passes over, or, in some types, when pressed by a man's foot. Mine fields may be destroyed by bombing or bombarding them. More often the mines are located by electrical detectors or by prodding the soil, and are dug out by hand.

A "booby trap" is a mine, wired to an apparently innocent object, such as a door knob or an abandoned weapon. Whoever moves the object sets off the mine.

HE DIGS OUT HIS HOME IN THE DESERT



With those powerful front legs and long claws, this desert tortoise of the Southwest digs a deep burrow to protect him from summer heat and winter chill. That front projection of his lower shell scoops up the earth like the blade of a bulldozer. When full grown, he is a foot long and the tough plated armor on his back is a dull brown. Coaxed with fruits and vegetables, he becomes a gentle pet.

TORTOISE (*tôr'tŭs*). Land turtles are often called "tortoises," and certain fresh-water turtles such as the terrapin are sometimes called "marsh tortoises." The name (from the Latin *tortus*, "twisted") refers to their feet. Zoölogically, turtles and tortoises differ little; both belong to the reptile order *Chelonia*.

The land turtles range in size from the European tortoises that fit into coat pockets to the giant tortoises that may have shells more than four feet long and weigh 500 pounds. The giant tortoises live in the Galápagos Islands of the Pacific and in the Mauritius and other island groups of the Indian Ocean. Hunted for their meat and oil, they have become almost extinct. They grow so tame in captivity that they may be ridden by children.

The tortoise shell used for combs and ornaments is provided not by the tortoise but by the smallest of all the sea turtles, the hawksbill. (*See also* Turtle.)

TOUCAN (*tu-kän'*). The toucan is a bird freak, for it has an enormous bill larger than its head, shaped like a great lobster claw, and marked with bright colors. The tongue is also unusual, for it has side notches and is flat and featherlike; and the tail is joined to the body with a ball and socket joint, and can be raised above the back with a jerk. The black and green plumage is marked with white, orange, red, or blue; and the eye, with a double iris of green and yellow, has a broad blue orbit and is surrounded by a patch of bare orange skin. There are 50 to 60 species, distributed from Mexico south to Argentina.

The common toucan, *Rhamphastos toco*, is two feet long with its eight-inch beak. The beak is very light but strong; paper-thin on the outside, it is reinforced on the inside with a honeycomb of bone. This toucan lives in Guiana, Brazil, Bolivia, and Argentina. It eats mostly seeds and fruits, and can ruin orange groves. It also eats small birds, reptiles, and insects. The nest is in a hollow tree; the two eggs are white and glossy. Usually it is easily tamed.

TOUCH. "How many senses have you?" The answer most people give to this question is "five"; and they name touch as one of the five. But a little experience and thought show there are really four separate senses localized in our skin. Often the sensation we get from contact with objects is a combination of two or more senses.

First there is true touch or "tact." This is aroused by light contact of any object with the skin.

Second, there is the sense of cold aroused by objects of a lower temperature than the skin. This anybody recognizes as quite different from touch. Indeed, it does not require contact of any solid object at all. If there is a cold object near by, we know it.

Third, there is the sense of warmth. This is quite distinct from both touch and cold and is felt when the temperature of the skin is raised.

Fourth is pain. This is caused by excessive stimulation or injury. Any sensation may become painful if its intensity becomes too great.

It can be shown by going carefully over a small area of skin with a light hair or wooden point that the touch sensation can only be aroused in certain small spots. This is because there are special nerve endings for touch and these are scattered closely throughout the skin. So too with the other senses; each has its own nerve fibers, its own pathways in the spinal cord, and its own center in the brain.

You can test the sensitiveness of touch in several ways. For example, take a pair of compasses and find out how far the points need to be spread apart in order to be recognized as two. This is a good game for two to play. One should be blindfolded. The other should lightly apply the compass points, one or both at a given moment. The first person should say whether he feels one or two points. See how many mistakes you make playing this game.

On the lips and fingertips you will recognize the two points when quite close. On the back of the hand or of the neck they must be quite far apart.

If one takes a cold blunt point, he can localize "cold spots." These are sensitive to cold but not to touch or heat. Heat and pain spots can be found by similar experiments.

The Sense of Location on the Skin

We are so used to being stimulated by contact in various parts of the body that we can tell pretty accurately what spot is being touched. This is called the "local sign." Another good game is for a blindfolded person to put a finger as exactly as possible on some spot another person has just touched with a pencil or toothpick. You will find that there is a good deal of difference in the exactness of localization on various parts of the skin.

Touch is important in giving us information in regard to contact, shape, smoothness or roughness, etc. You can "fool" the sense of touch if you get the endings out of their usual relation. For example, cross your fingers and feel of a marble or the end of a pencil. It will feel like two objects.

In addition to the four senses already named there is a sense of pressure, connected with the muscles and joints and the skin. By this we judge weights. By the so-called "muscle sense" one can tell the position of any limb pretty accurately. If the arm of a blindfolded person be bent by another person, the first can tell at about what angle the arm is bent.

In the blind the sense of touch becomes very important and can be cultivated to a high degree. Helen Keller, who was blind and deaf from babyhood, became a very wise and cultivated woman by learning to read and converse by the sense of touch. (*See* Blind, Education of.)

Township. When the Puritan Fathers came to Massachusetts they settled in little compact communities called "towns" or "townships." In each of these a meeting-house was erected for church services, and there the voters of the town also met from time to time in town meeting to make their local laws, elect their local officials—especially their "selectmen" or executive committee—and transact other business. The other New England colonies, as they were established, adopted the same form of local government.

In colonial Pennsylvania most of the duties discharged by the New England town meeting were assigned to the county governments. But still there were a few functions which could best be performed by officers of a smaller community, and so Pennsylvania too adopted a "township" government. In this colony, however, no town meetings were held, for the township officials were elected at the general election and the administration of the township was left entirely in their hands. New York and New Jersey adopted a plan of township government midway between Pennsylvania and New England. In the colonies south of Pennsylvania, local government centered in the county and the parish.

In the new states north of the Ohio River and east of the Mississippi, and in the first tier of states north of Arkansas and west of the Mississippi, township government was adopted of the New York or Pennsylvania type. In the other states of the South and West there are no townships in the political sense.

In five other states that have township government —Ohio, Indiana, Missouri, Iowa, and Kansas—there are no town meetings, and the officials are elected by ballot at the time of the general election. In the other states which have townships, outside of New England, the officials are elected and the more important business transacted at a town meeting of the voters of the township, but these meetings are only faint shadows of their New England prototypes. The meetings are usually held in the spring of each year, but may be called at other times. The officers elected include supervisors or members of the executive committee by whatever name they are known, a town clerk, assessor, treasurer, constable, etc.

The functions of the township government include the building and upkeep of country roads, bridges, and schools, the administration of poor relief, and taxation for those purposes. Often the township officials will order you to cut the weeds along the road adjoining your property, muzzle your dog during the hot summer days, and keep your horses and cattle from running at large.

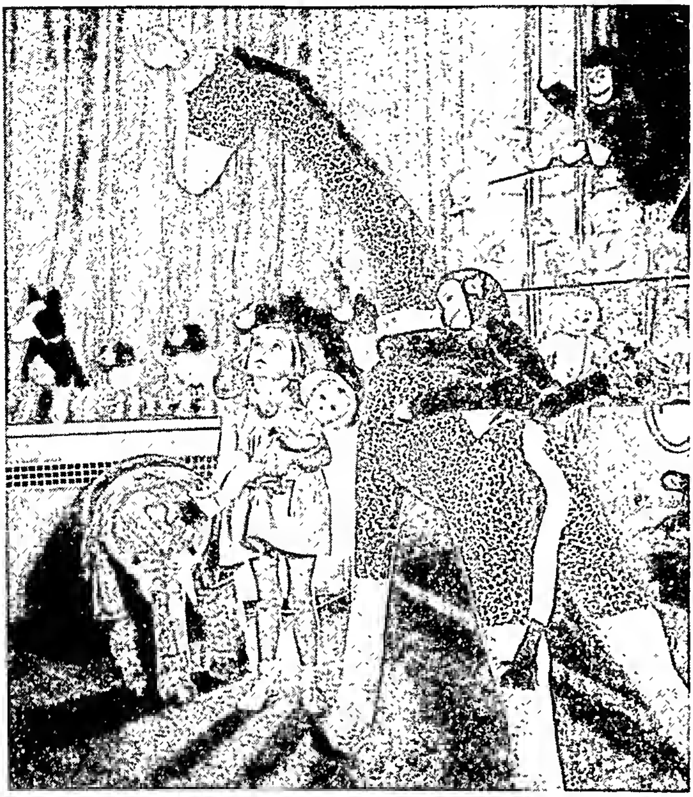
The people living in cities in most cases do not take part in the town meeting or in the township elections, for they are under municipal rather than township government.

The word "township" is also used in another sense, as a unit of the surveys of public lands made for the federal government since 1785. Such townships are usually six miles square. In many states the boundaries of the political and the land survey townships coincide, but this is not necessarily true.

New England towns and town meetings remain vital and useful local government units. Elsewhere in the country the township functions largely duplicate the municipal and county services. Most voters do not pay particular attention to candidates for township offices, with the result that unqualified men are often elected.

For these reasons the township unit of government has been widely criticized, and in several states there has been a gradual transfer of township functions to municipalities and counties. In other states township governments are being abolished completely, county by county.

How to CHOOSE TOYS *Wisely*


Clutching her favorite doll, this little girl stands in wide-eyed awe of the huge giraffe in the stuffed-animals corner of the toy shop.

TOYS. Children probably have always had toys. In the pyramids of Egypt and the burial mounds of ancient Persia many dolls and toy animals have been found. In the ruins of ancient Crete diggers have found exquisite dolls with embroidered gowns decorated with precious stones. These probably had religious significance as well. Kings and noblemen of centuries ago left doll houses elaborately carved by skilled craftsmen. Toy knights have been found with plated armor in exact replica of that worn by real knights. In American colonial times children had dolls, doll furniture, dishes, and clothing and other toys.

While there have been toys since early times, the children did not play with them in the way that children today play with their toys. An understanding of the role of play in a child's life has come only in recent years.

Watching a child with his toys, one gets a deeper understanding of the meaning of playthings. With them the child investigates, experiments, explores. He handles, takes apart and puts together, builds, and creates. He finds out things that adults have forgotten they ever had to learn. With his toys a child plays out the scenes of his daily living, and with them he can have hours of happy, wholesome fun. If this is to be so, toys must be chosen to fit what the youngster is able to do and likes to do right at the time he is ready to use them. Toys need to be changed as the child grows and changes.

No one can say exactly what toys are right for any given child. Children differ, and parents and homes differ. However, the general facts about child development help indicate the types of toys that are suitable for different ages. Older children in the family can help their parents learn what the baby and little children are ready for in their play. They can also figure out what they themselves are ready to use. The suggestions given in this article are for all the family to use in choosing toys.

For the Baby

For the lying-down baby (*under six months*). Brightly colored soft balls, balloons on a string, a gay little doll will one day be noticed if dangled in the baby's line of vision. Rattles soon catch attention, especially the musically toned ones. The baby will be ready to hold them himself soon, so they should be easily grasped. With a squeaky rubber toy he will coo, gurgle, and wave his arms and legs. He will notice an exercise toy fastened across his crib even before his hands can hold the rings. Toys that fasten to the crib are good because they are always at hand when the baby is ready to grasp or hit at them.

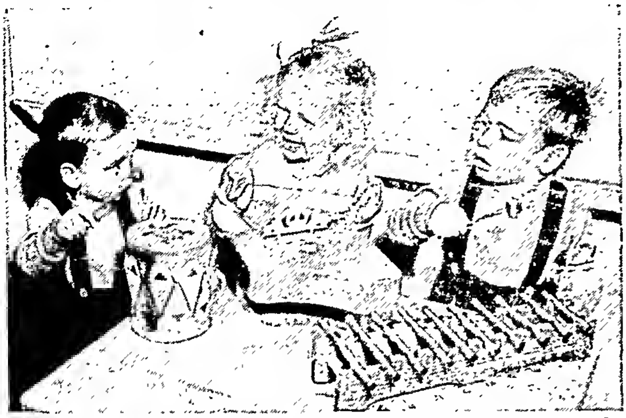
A baby's toys should be cleanable, free from sharp corners or edges, and with no loose parts to be swallowed. Some babies cut teeth during the first six months, so even the first toys must be those that can be chewed safely.

For the sitting-up baby (*six months to nearly a year*). Some babies sit up steadily before six months, others later. They use their hands with increasing skill each day. This is the time for cuddly dolls and soft, woolly animals. Babies love to feel and hug them. Floating toys add to bathtime fun. As the baby's hands and arms grow stronger he enjoys shaking, rattling, and thumping a string of big wooden beads. A string of tinkling bells gives him great pleasure. A nest of blocks to take apart and put together is suitable at this age, although at first the baby will only play aimlessly with them. It is also time for small rubber, plastic, or wooden blocks. Some plastic blocks have interest-catching rattling figures inside. The baby will have fun dropping the blocks into a little light basket and tipping them out again. He may be interested in small cloth or plastic picture books. All the baby's toys must be large enough to prevent him from swallowing them.

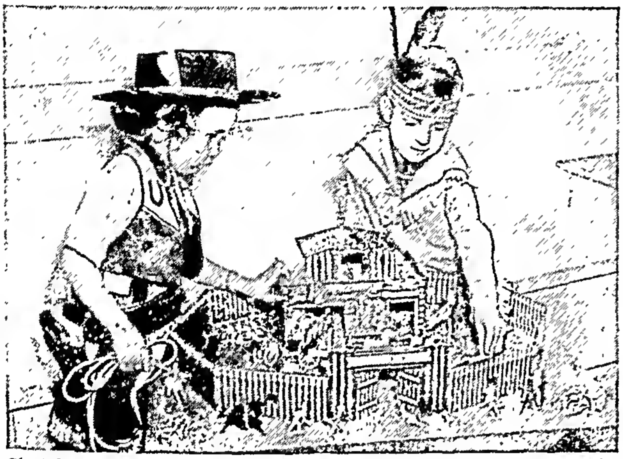
For the Little Child

For the walking child (*nearly a year to two years*). When youngsters begin walking, a new world opens to them. Their play expands noticeably. Now is the time for push-pull toys—the chiming toys and the animals that squeak, clack, or quack as they are pulled along. A light little wagon or an easily handled doll buggy gives good fun. Big hollow blocks are good for climb-

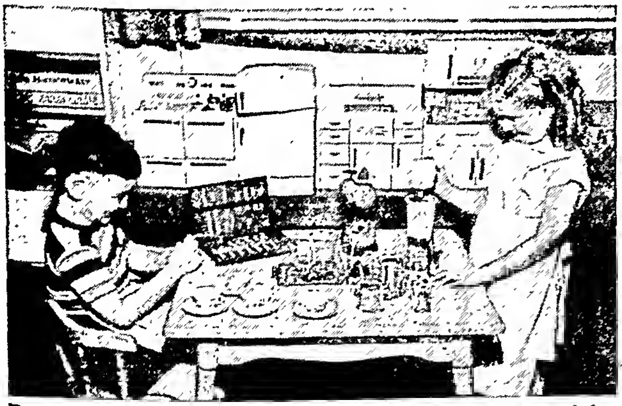
A VARIETY OF TOYS FOR YOUNGSTERS



A tom-tom, a toy piano, and a toy xylophone make the rhythmic, noisy "music" that all children love. Bells, tambourines, and horns help fill the small child's need for musical toys.



Clad in cowgirl and Indian costumes, these children are absorbed in their frontier-life game. Their fort is manned with attacking Indians, defending settlers, and Pony Express riders.



Even a boy likes to play house when his girl playmate serves juice made in a real mixer. A toy stove, refrigerator, kitchen sink, and cabinet supplement the furnishings on the table.

ing. Pounding sets furnish many moments of fun. The child needs things to take apart and put together—nests of blocks, color cones and towers, peg boards and peg carts (with large pegs), trains and boats with detachable parts.

Aluminum or plastic doll dishes and pots and pans with lids serve the double purpose of being fun for handling or fitting together and for later housekeeping play. At this age children like dolls, patting and rocking them one moment and swinging them by an arm or leg the next. They like to feel stuffed animals, carry them around, and take them to bed. Some of these animals can be on wheels for pulling around. Balls of all sizes fill a need all through childhood. A small pail and shovel come in handy for digging. A tom-tom can be added to the earlier musical rattles and bells, and little music boxes are intriguing.

In all homes there are everyday objects that a child will convert into playthings. Pots and pans are always favorites. Clothespins are a never-ending source of amusement, especially if there is a cardboard box to clip them to. Bits of string and yarn are put to many uses. A wooden spoon and a chopping bowl to pound on, a set of measuring cups to fit together, measuring spoons, a flour sifter—all these will be used again and again. Empty coffee cans with smoothly rounded edges, cottage cheese containers, and paper cups add to the fun.

A good idea for parents is to have a playthings box in which to save any objects which might serve play purposes. Old scarfs, bits of ribbon, strips of cloth, old purses can be held in the box until the youngster is ready for them. There are always playthings to be made out of boxes, spools, and odd bits of lumber. Ingenuity at using things right at hand yields playthings that enrich play all through the childhood years. (*See also* Play Materials.)

Definite places for keeping toys should be provided. These places should be within the child's reach, so that he can get the toys himself and eventually learn to put them away when play is over.

For the running-around child (*two to four years*). At this age wheel toys—a small tricycle, a wagon, a sturdy doll carriage—are important. Animals on wheels and trucks or cars big enough to straddle and ride are more fun than ever. It is the heyday for climbing. Big hollow blocks come in handy both for climbing and for quick building. A little light ladder to carry here and there offers adventure.

The child has a driving urge to be active and thus needs plenty of things for outdoors physical play—a swing, seesaw, perhaps a slide. Damp sand and sand toys are useful. Sand tunnels, bridges, and roads need little vehicles. A collapsible wading pool and inflatable water toys offer hours of warm-weather fun.

Because of rapid growth in motor co-ordination, the manipulative toys of earlier days will be used with more skill now. It is wise to add more complicated ones—barns with detachable parts, trains that separate. Simple puzzles at first, then harder ones will be enjoyed. Finger painting is great fun. So is an easel with jars of paint and large brushes. They should be set on linoleum or spread-out newspapers so that the painting will not be discouraged by too many warnings not to spill or splash. Clay will be enjoyed at first for pounding and rolling, then for forming some object. When the time comes for using crayons, the child should have big, easily grasped ones and big sheets of paper to work on.

This is the age for a set of building blocks cut on unit size, one that can be added to later. At first children will lay the blocks end to end or simply pile them up. Then they will begin to name the structures and make more or less recognizable houses or barns. They will need people for the houses, animals for the barn, as well as small autos and trucks. Family sets of small dolls and rubber or plastic farm sets are good for play either with the blocks or by themselves.

At this time the child plays imitatively and imaginatively. Girls need tea party sets with child-size tables and chairs and cooking, cleaning, and laundry sets. A toy telephone will get good use, and adult conversations will often be reproduced with amazing accuracy. Much play centers around dolls and doll furniture.

Interest in dressing up begins early. At first, gloves, a hat, a discarded pocketbook, a strip of gay cloth will satisfy this play need. Later a fireman's hat, a postman's cap, Indian or cowboy outfits, doctor or nurse kits, and other simple play costumes will start all sorts of play.

It is nice for a child to have a growing collection of musical toys. A toy piano, correctly tuned, is suitable now. Musical tops are fun. A few good records with inviting rhythms are almost sure to bring some sort of rhythmic response. With a tambourine or a triangle the child can keep time with the music. Simple singing records give opportunity for the youngster to join in.

For the Growing-up Child

For the child who is expanding his interests and becoming more social (four to six years). To the basic block set can now be added more blocks, some with new shapes—cylinders, curves, and wedges. The child's growing awareness of neighborhood and community details shows in his block building. This suggests the need for street accessories and a supply of vehicles. Village sets, complete with small buildings and street equipment, are useful. Simple construction sets that can be put together in varied ways help satisfy interest in manipulation and experimentation. Older brothers and sisters can have fun with the children with these sets. A sturdy work bench with vise, a few good tools, and soft wood in varying sizes offers opportunity to make whatever the need of the moment suggests.

Imitative, imaginative play becomes slightly more organized during these years. The child needs plenty of equipment for such play—dress-up outfits, cowboy and Indian regalia, army and navy outfits; cash register, scales, and toy money for store play; circus sets; transportation toys; and toys that suggest community activities. Hand puppets are fun and are easily managed. They offer opportunity for endless talk and simple shows. Older children can help the younger ones dress the puppets. Dolls and doll accessories will still hold attention, with more interest now in realistic detail. To the earlier dishes can be added knives, forks, spoons, and napkins so that the table can really be set.

In time, interest in words and numbers begins to show more clearly in the play. Stores must now have signs, containers must have labels, tickets are in demand for shows, bus rides, and train trips. These needs suggest a simple printing outfit. Scissors with blunt edges are needed too, for the child's hands are well enough under control to manage them. Paste and crayons naturally accompany scissors. Finger and easel paints still have an important place. Some of the "stick-'em" magnetic sets offer fun in design experiments. A blackboard is always useful, especially the white ones on which special colored

LEARNING COMMUNITY LIFE THROUGH TOYS

Blocks of various sizes and shapes help children create imaginative structures and even whole communities. Blocks can be supplemented with small dolls, toy animals, and toy vehicles.

A toy fire truck with an extension ladder that works like a real one delights the boy who seeks imaginary adventures in his play. Toys such as this help a child learn about community services.

crayons show up well. Puzzles can have more pieces now, but they still should not be intricate. To the earlier musical instruments may be added a well-tuned xylophone, marimba, cymbals, and perhaps a harmonica.

Increased motor skill and continued interest in active play suggests playground apparatus, roller skates, wagons, and sleds. Wheel toys are a continuing source of joy and wholesome exercise. They should be chosen carefully to fit lengthening legs and growing bodies.

For the child who is becoming more interested in skills, using language fluently, handling his body with ease (six to eight years). With increased skill in balance and motor control, tricycles soon need to be replaced with two-wheelers. Two-wheelers with auxiliary training wheels are often useful. These can be removed when the youngster feels sure of himself. He will likely show interest in scooters, stilts, skis, and ice skates. Girls want jumping ropes and become very skillful in their use. Trapeze bars, rings, and parallel bars afford opportunity for the active physical play that growing muscles demand.

Collections begin to flourish in this period, especially with boys. Often these last only a little while, and the interest shifts to something else. Electric trains seem to fit a real need at this time. It is a good idea to begin with a basic outfit of cars and tracks and add to it as years go by. If possible, the tracks should be set up permanently so that the child can use the set as often as he wishes.

Increasing manual skill and finer co-ordination suggest simple crafts. A work bench with a kit of usable tools gives the boy a chance to make a variety of things. Model sets of boats, planes, or trucks are interesting and may start a hobby. Metal construction sets offer opportunity for experimental construction. Simple weaving, knitting, and block printing appeal to some children. Girls have a growing interest in having dolls well dressed. This suggests sewing kits and even doll dress patterns. Interest in small dolls, miniature furniture, and a doll house is very evident now. Paper dolls provide hours of fun, and the fashion magazines offer all sorts of dress designs to be made with paints and crayons. Much dramatic play centers around the dolls. This is also the time for real cooking sets. Many children have learned the essentials of cooking with such sets under their mothers' tutelage.

Growing ability to read, write, and use numbers easily leads to such games as anagrams, dominoes, and various reading and spelling games. Games calling for two or more players often require scoring and thus provide a chance to use basic number facts.

For the Almost Grown-up Child

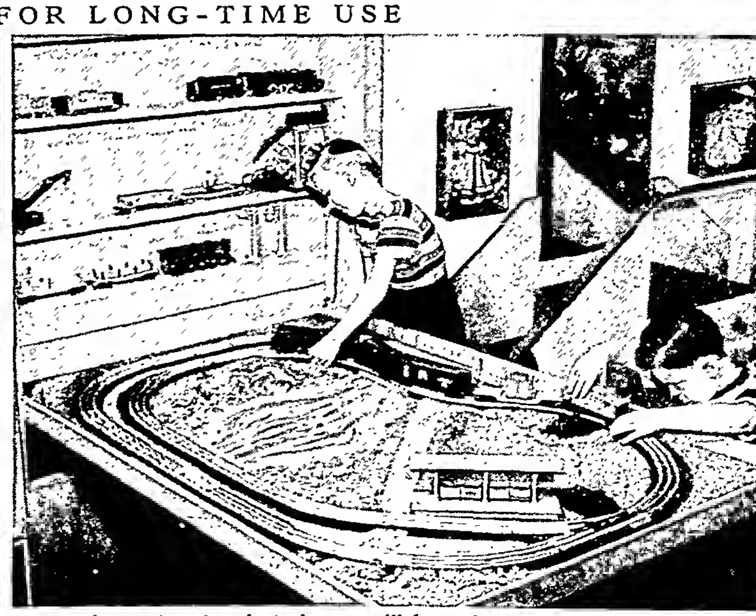
For the child who is perfecting skills, exploring interests purposefully, becoming one of a group or team (eight to ten years). Bodies are under control now, and hands are skillful. The child can do all sorts of interesting things if he is willing to apply a continued effort to them. He knows words and numbers; he can read accurately and follow printed directions. He has learned how to get along with playmates and has fun doing things with others.

Many children want to become skillful at some sport or game. Boxing gloves and a punching bag are fun for some boys. Girls often become adept at simple sewing or playing jacks or hopscotch.

Boys are ready for more difficult construction sets. They invent their own models as well as follow instructions that come with the set. Building blocks are useful now for experimenting with different building designs. Some children may lay out whole communities. Additional pieces for the electric train set

TOYS FOR LONG-TIME USE

Wheeled toys such as this tricycle provide the outdoor exercise and opportunity for active play that all children need for growth. Wagons, scooters, and sleds help fill the same vital needs.



An electric train set will be enjoyed and added to for many years. This one is set up on a base that folds into the wall. Rolling stock and other equipment can be stored on the shelves.

provide more enjoyment, and entirely rearranging the tracks adds new interest.

For the youngster who likes to explore and experiment, the field of science is full of interest. Sets for studying soils and rocks, chemistry sets, atomic energy outfits, telegraph sets, and the like are available. The "space" toys spark imagination. A magnifying glass, microscope, or telescope open up whole new worlds. A camera furnishes hours of enjoyment and may lead to a lifetime hobby.

Earlier interest in dolls and housekeeping play now leads to realistic projects such as learning to take care of real babies, learning more about sewing, real cooking, or home decorating. There are toy sewing machines that really sew, electric stoves that actually cook, electric irons that work, electric mixers that really mix. A girl can learn much about good housekeeping and have fun doing it.

Dramatics can now be more organized and more elaborate than before. With costumes, masks, and simple stage properties, a group can put on plays of their own devising or those based on familiar stories. String puppets can be manipulated easily now, and preparing a puppet show requires many different handicrafts and language skills (*see* Puppets). Enjoyable activity of another sort may be found in handicraft sets—weaving frames, spinning looms, equipment for plastic work, block printing outfits, embroidery sets, and spool knitting.

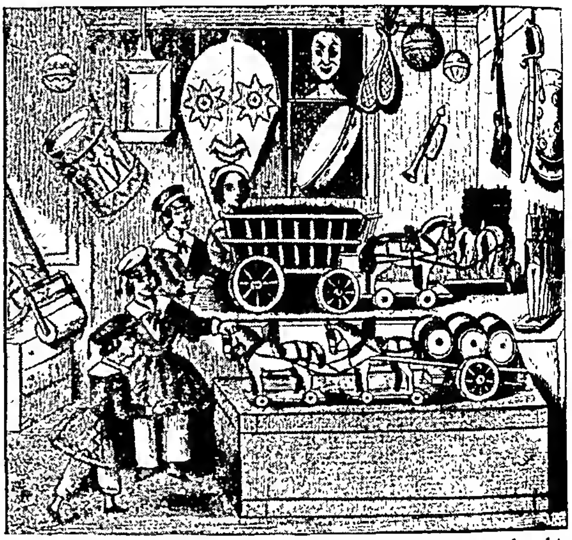
Games involving school subjects can be vastly interesting. Jigsaw puzzles involving maps are always fun. Some children enjoy drawing special maps showing a country's products or its native animals and flowers. Collections offer endless possibilities. Trader cards, stamps, shells, stones, coins, grasses, flowers—these and many more are open to boys and girls. Collections should be kept in a special place to be given proper care and display.

For the child who chooses activities wisely, eager to learn new skills (ten and over). Big boys and girls need many things to help carry out their interests and to explore new ones. They like group games and sports that require skill in playing, competition, and working for the team. Some older children want to try golf, swimming and diving, skating, fishing, or other noncompetitive sports.

Quieter games offer companionship and competition. These include checkers, chess, other board games, card games, marbles, jacks, and anagrams. Magic and sleight-of-hand outfits provide good fun in a crowd. Many games are now possible because of a growing fund of knowledge; the game, in turn, often adds to the store of facts. (*See also* Play and Games.)

By this time many people begin to select hobbies that are of lasting interest (*see* Hobbies). For some it will be stamps or other collections (*see* Stamps). Others will enjoy photography (*see* Photography). Perhaps the interest will be in general science or in one of its branches, such as chemistry, electricity, or radio. Kits are available for these hobbies and for crafts such as stenciling, leatherworking or metalworking,

A TOY SHOP OF LONG AGO



Like boys and girls today, children of 150 years ago loved to admire the wonderful world of toys at the local toy shop.

jewelry making, wood burning, or weaving. Carpentry is an absorbing hobby, and the supply of tools and materials can grow through the years.

As a girl grows older, sometimes doll play leads to doll collecting (*see* Dolls). Miniature dolls or miniature doll dishes and furniture make good collections. So do miniature animals, cars, planes, and musical instruments.

Choosing Toys Wisely

Through all the years from babyhood on, toys provide hours of fun and enjoyment. With them a child tries out many ideas; in turn the toys serve to start new ideas. A child uses developing abilities and grows in skill with toys. They are at once his close companions and the means for companionship with others.

Toys must be chosen with thoughtful care. A child's toys should fit him at the time he will be using them. Toys that are too hard bring discouragement, and those that are too easy bring boredom. As the child grows and his abilities develop, his toys should fit his changing needs and his varied interests at any given time. His interests in active physical play, in imaginative, imitative play, and in constructive, creative play should all be provided for. Balance in a child's play activities is vitally important.

His toys must, of course, be safe to use. They should be free from splinters, from sharp edges and corners, and from anything that might catch and hurt his exploring fingers. Part of their safe use lies not only in their thoughtful choice but also in the guidance that helps a child know their proper use. For example the wooden mallet with the pounding bench is for pounding pegs, not other children or the coffee table top. Sand is to be used in the sandbox, not thrown at other children or poured over one's head. Finally, it is not the number of toys a child has that satisfies his play needs; rather, the ones he has must fit him and provide for what he wants to do at the moment.

Tests of SPEED, SKILL, *and* ENDURANCE

TRACK AND FIELD SPORTS. In earliest times men learned to run, jump, and throw heavy objects to protect themselves against attacks by wild animals. To practise these skills they organized foot races and tests of jumping and throwing. Later sheer physical strength became much less important to survival. But men continued to hold such contests just for the sport of competing against one another.

Today many of these contests are grouped together in an athletic program called a *track and field meet.* Running and hurdling events take place on an oval track made of dirt or cinders. Field events are held inside the oval. Field contests are jumping, vaulting, and weight throwing. The season for outdoor track meets extends through spring and early summer. Indoor meets are held in large stadiums or field houses during the winter.

Modern track and field sports are contested almost exclusively by amateur athletes. Teams from high schools, colleges, and athletic clubs compete against one another in dual meets and for conference championships. Most states hold an annual track and field meet to determine the state high-school champions.

Major track and field programs include those sponsored by the Amateur Athletic Union (AAU), the National Collegiate Athletic Association (NCAA), and the Intercollegiate Association of Amateur Athletes of America (IC4A). Outstanding contestants also take part in special invitational meets such as the annual Drake Relays, Pennsylvania Relays, and New York Millrose Games. The Pennsylvania Relays, founded in 1896, are the oldest of these meets. The Olympic Games, held every four years, provide international competition. They attract the best track and field athletes from countries all over the world (*see* Olympic Games; Athletics).

Flying Feet on the Cinder Paths

In all track events, runners crouch close to the cinders, waiting the starter's command of "On your marks," "Get set." Then at the bark of his gun, runners lunge into stride. The *sprints*, or dashes, are run at distances of 100 and 220 yards, with special 50-yard races for boys under 16 years old. The sprinter who holds the world record for the 100-yard dash is commonly called the "world's fastest human." Other running events are classified as *middle distance* (440 and 880 yards) and *distance* (one mile and longer).

Relay races are run by four-man teams. Each runner races one-fourth of the distance. Then, still at top stride, he hands the *baton* to a teammate. Relay races are run at 440 and 880 yards, and 1, 2, and 4 miles. Hurdle races are running events in which the contestants leap over a series of ten wooden barriers. In the 120-yard race the hurdles are set 3 feet, 6 inches high; in the 220-yard race, 2 feet, 6 inches high; and in the 440-yard race, 3 feet high. The best hurdlers "scissor" their legs to clear the barriers without breaking their running stride.

Most runners use aluminum or wooden starting blocks to speed their take-off at the beginning of the race. The finish line is marked by a *tape* which the winner breaks with his chest. Stop watches time each race to the exact tenth of a second.

Field Events Test Muscular Coördination

One of the most spectacular of field events is the *pole vault.* The pole is usually made of light

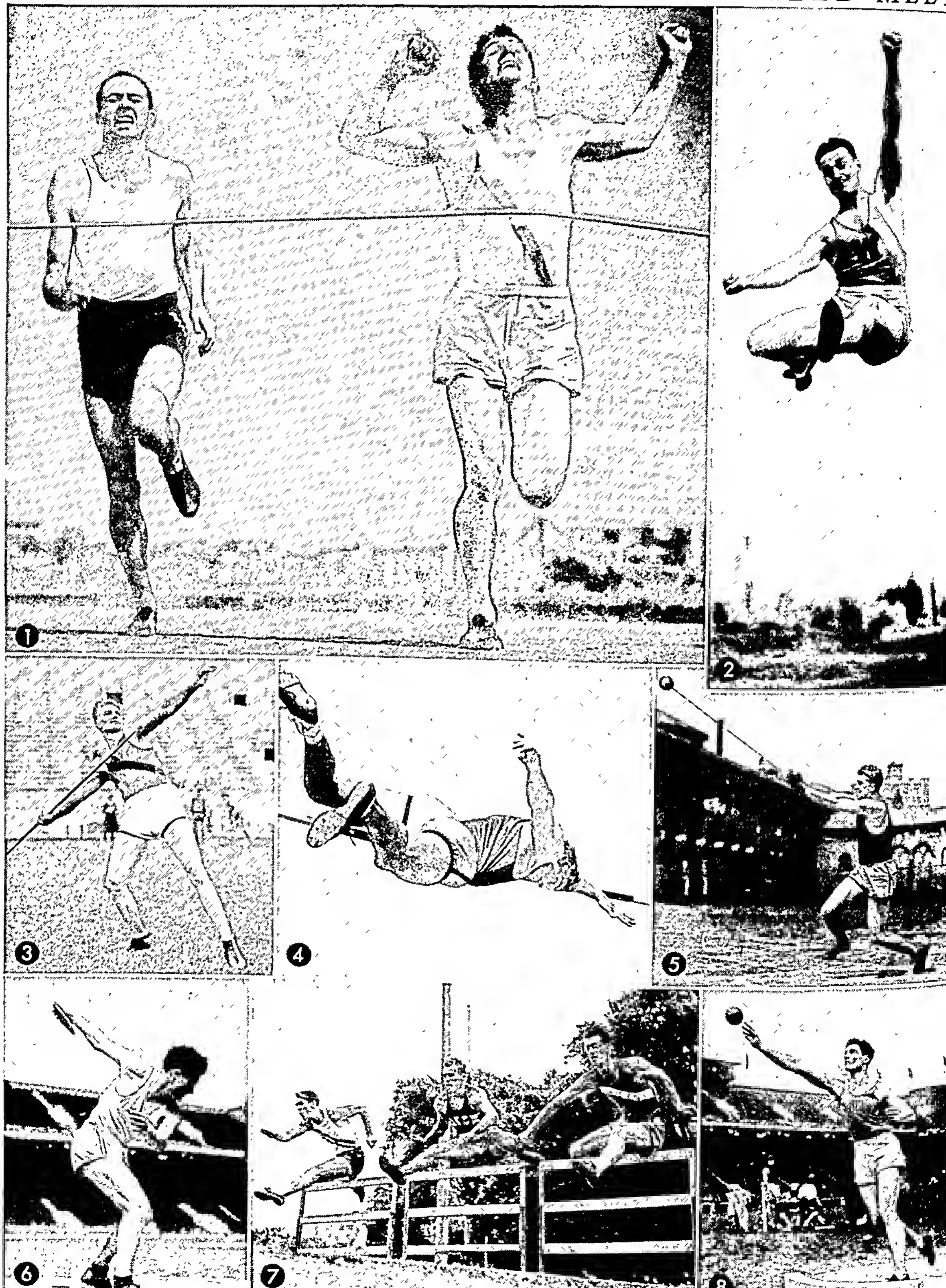
OFFICIAL WORLD RECORDS IN TRACK AND FIELD SPORTS

Event	Record	Champion	Nation	Where Made	Date
100 yds.	9.3 sec.	Mel Patton	United States	Fresno, Calif.	1948
220 yds.	20.2 sec.	Mel Patton	United States	Los Angeles, Calif.	1949
440 yds.	46 sec.	Herb McKenley	Br. W. Indies	Berkeley, Calif.	1948
880 yds.	1 min. 48.6 sec.	Mal Whitfield	United States	Turku, Finland	1953
1 mile	3 min. 58 sec.*	John Landy	Australia	Turku, Finland	1954
2 miles	8 min. 40.4 sec.	Gaston Reiff	Belgium	Paris	1952
120-yd. hurdles	13.5 sec.	Richard Attlesey	United States	Fresno, Calif.	1950
220-yd. hurdles	22.3 sec.	Harrison Dillard	United States	Salt Lake City, Utah	1947
440-yd. hurdles	51.6 sec.	Charles Moore	United States	London, England	1952
High jump	6 ft. 11½ in.	Walter Davis	United States	Dayton, Ohio	1953
Broad jump	26 ft. 8¼ in.	Jesse Owens	United States	Ann Arbor, Mich.	1935
Pole vault	15 ft. 7¾ in.	Cornelius Warmerdam	United States	Modesto, Calif.	1942
16-lb. shot put	60 ft. 10 in.*	Parry O'Brien	United States	Los Angeles, Calif.	1954
Discus throw	194 ft. 6 in.	Fortune Gordien	United States	Pasadena, Calif.	1953
Javelin throw	258 ft. 2⅜ in.	Yrjo Nikkanen	Finland	Kotka, Finland	1938
Hammer throw	200 ft. 11 in.	S. Strandli	Norway	Oslo, Norway	1952

*Subject to approval by International Amateur Athletic Federation

All official world records must meet certain standards to win approval by the International Amateur Athletic Federation. For example, a tailwind of more than 4½ miles an hour would disqualify a record performance made in a sprint or hurdle race.

TYPICAL EVENTS OF A TRACK AND FIELD MEET



The athletes pictured here are competing in some of the events which make up a track and field meet. 1. A sprinter lunges against the tape at the finish of a dash. 2. An agile broadjumper leaps through space. 3. A javelin thrower poises for a toss. 4. A high jumper seemingly floats over the bar in a graceful demonstration of form. 5. A sturdy competitor "winds up" for the hammer throw. 6. A discus thrower gets "set." 7. Hurdlers graze the tops of the high "sticks." 8. Putting the 16-pound shot.

bamboo or aluminum and is from 12 to 16 feet long. Aided by this pole, contestants try to vault over a horizontal bar placed between two uprights. From a running start, the vaulter propels his body over the crossbar and then pushes the pole free (for picture, *see* Athletics).

In the *high jump* contestants attempt to leap a bar set between two standards. They may run at the bar from any distance or direction. The two most popular styles of jumping are the Western Roll and the Eastern Form. In the Western Roll the jumper approaches the bar from an angle of about 45 degrees. He leaps from his inside foot and clears the bar with his body parallel to it. A jumper using the Eastern Form approaches the bar from an angle of about 60 degrees. He springs from his outside foot, crossing the bar feet first.

Contestants in the *broad jump* make their leap from a take-off board while running at top speed. The length of the jump is measured from this line to the point where the jumper first touches the ground again. The *hop, step, and jump* is usually not held except in the Olympic Games. It consists of the total distance covered by executing the three movements in rapid succession.

The *hammer* is a 16-pound metal ball attached to a 4-foot length of wire rope. Gripping the end of the rope the contestant gains momentum for his throw by first whirling the hammer about his head as fast as he can. The throw is made from a circle 7 feet in diameter.

In the days of ancient Greece the *discus* throwing champion was hailed as the greatest of all athletes. The discus is a hardwood plate bound by a ring of steel. It measures 8⅝ inches in diameter and weighs about 4½ pounds. The thrower stands in a circle 8 feet 2½ inches in diameter and hurls the discus so that it spins through the air.

The *javelin* is a long, metal-tipped pole. After a short run to gain momentum the contestant throws it like a spear. The javelin is about 8½ feet long and weighs about 1¾ pounds. Another weight-throwing event is *putting the shot*. From inside a 7-foot circle, the contestant takes one hop and then "puts" the shot into the air at an angle of about 40 degrees. The standard shot is an iron ball weighing 16 pounds; high-school athletes use a 12-pound shot.

Tests of Skill and Endurance

The winners of the *decathlon* and *pentathlon* are generally acclaimed the best all-around athletes. (For these events, as in the Olympics, track distances are measured in meters rather than yards.) The decathlon consists of ten events—100-meter race, broad jump, shot put, high jump, 400-meter race, 110-meter hurdles, discus, pole vault, javelin, and 1,500-meter race. The contestant scoring the greatest total of points in all events is the winner.

The decathlon is scored on the basis of "maximum performance" in each event. For example, a contestant running the 400-meter race in 44.6 seconds receives the maximum performance score of 1,510 points. For each one tenth of a second slower or faster time he loses or gains points. A maximum performance in all ten events is worth 15,268 points. Bob Mathias of Tulare, Calif., set the world record of 7,887 in 1952 at Helsinki, Finland.

The pentathlon has five events—broad jump, discus, javelin, 200-meter race, and 1,500-meter race. For Olympic competition this sport has been replaced by the *modern pentathlon*, based on military skills. It consists of competition in riding, fencing, shooting, swimming, and running.

Special track and field meets are held each year for women athletes. Foot races cover distances from 50 yards to one-half mile. Women also compete in low hurdles, relay races, and five field events—high jump, broad jump, shot put, discus, and javelin. These last five events are also grouped into a special women's pentathlon. (The shot weighs 8 pounds, the discus 2¾ pounds, and the javelin 1½ pounds.)

Track and field sports require a high level of physical strength and endurance. The athlete must train intensively and constantly practise his technique in order to excel in his event. As a result of the special demands of each sport few athletes participate in more than two events. A notable exception was the performance of Jesse Owens in the 1936 Olympics held in Berlin. This Negro athlete from Ohio State University won three individual events—the 100- and 200-meter dashes and the broad jump—and also ran on the winning 400-meter relay team. In addition, he set new Olympic records in the 200-meter dash and broad jump.

How World's Records Are Judged

The first official track and field records were made in a meet between Oxford and Cambridge universities in 1864. Since then athletes from many nations have made successively better marks. A new world's record in each event is set about every six years.

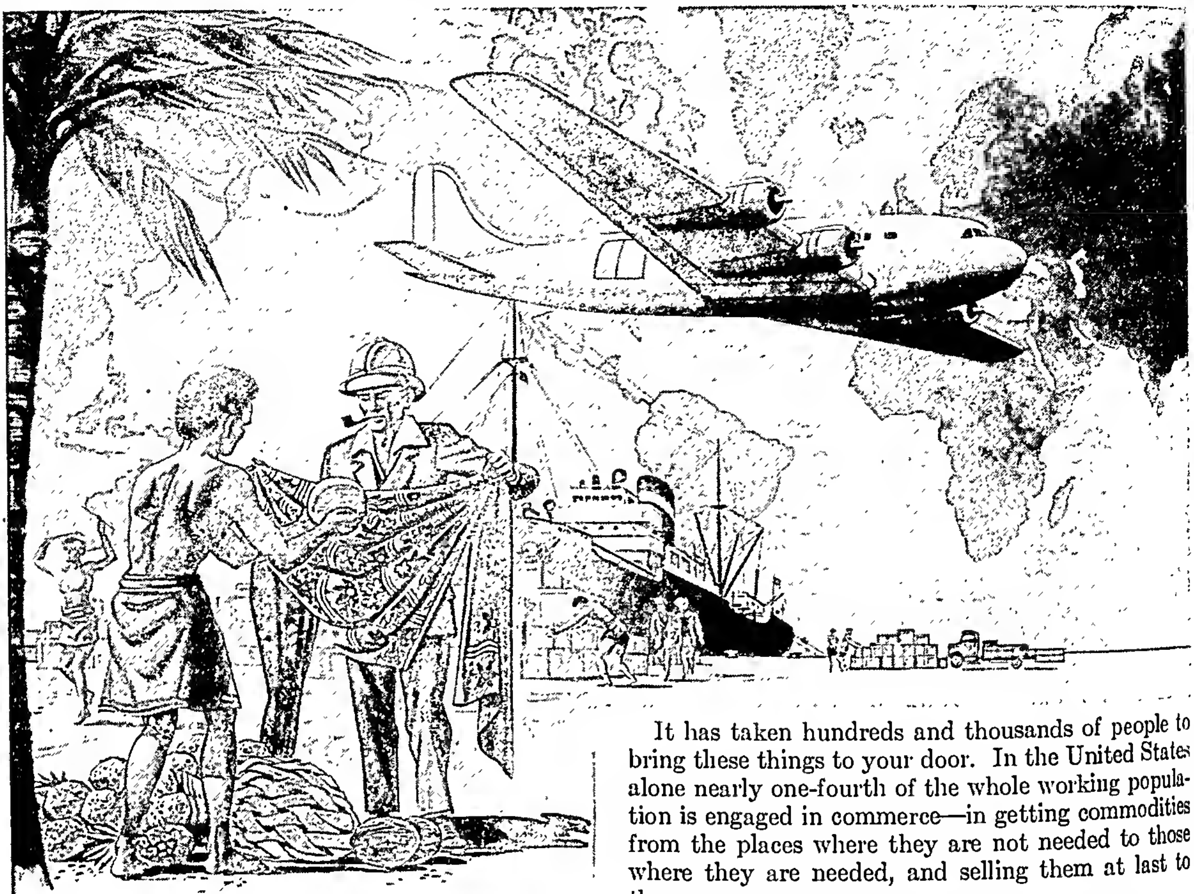
To qualify as a new record, a performance must meet definite standards such as timing, wind velocity, and track conditions. If the record is approved by local officials it is then submitted to the Amateur Athletic Union for recognition. The AAU decides whether it is an official American record. The mark must be approved by the International Amateur Athletic Federation before it becomes a world's record.

Running over Hills and Fields

Cross-country races vary in length from about 2 miles for high-school runners to 5 miles for college athletes. The course is usually laid out to include a variety of terrain such as hills, meadows, and roads. These races may be contested by individuals or by a group running as a team. Cross-country runners are commonly called *harriers*, derived from the old chasing game of Hare and Hounds.

Marathon races have been popular since the days of ancient Greece (*see* Marathon). Contestants usually cover the standard distance of 26 miles, 385 yards in less than 2½ hours. The leading marathons in the United States are the AAU, first run in 1925, and the American, held annually at Boston since 1897.

TIES *of* TRADE *That Unite the* WORLD



TRADE. Our lives would be narrow and uncomfortable without trade. It brings us good things from every part of our own rich country. And the islands of the East are our spice gardens, India is our tea plantation, Argentina and Australia our cattle and sheep ranges, Africa our gold and diamond fields.

Look at the breakfast table before you this morning. There are bananas from Central America and sugar from Cuba. Far-away Brazil produced the coffee, and the pepper came from the island of Borneo. New York State perhaps sends you your salt, and a farmer of North Dakota raised the wheat which the great mills of Minneapolis ground into flour for your morning bread. Your cocoa is made from the seeds of a tree which grew in Ecuador. Perhaps the table itself grew as a mahogany tree in Honduras.

A ship laden with wool sails from Australia to England. There the wool is spun into thread and woven into cloth. The cloth is perhaps colored with dyes from Germany, and sent to America and made into clothes for you in New York or Philadelphia; the shoes that you wear may have come from hides of cattle that roamed the plains of Argentina or of goats in Asia or Africa, and were manufactured perhaps in Massachusetts. The curtains at your windows may have been woven in England or Switzerland; and your fine linens, in Ireland.

It has taken hundreds and thousands of people to bring these things to your door. In the United States alone nearly one-fourth of the whole working population is engaged in commerce—in getting commodities from the places where they are not needed to those where they are needed, and selling them at last to the consumers.

To pay for these commodities the United States sends wheat and cotton and tobacco, plows and automobiles, machinery, and petroleum products. So the world goes on, each section producing the commodities for which its climate, its natural resources, and its people are best adapted, and trading its surplus in turn for the things produced in other sections.

The Earliest Trade Routes

The first travel-trading was conducted across deserts. The earliest we know of was between the Tigris and the Nile, by large caravans, heavily guarded, taking many days to traverse the dreary wastes of sand and scorching heat. Hence, the goods carried were of small bulk but large value, such as gold, ivory, drugs, spices, gems, and cloth. This early commerce seems to have been in the hands of Arabs. In Genesis xxxvii, 28, we read of the sale of Joseph by his brothers to such a company of traders on their way to Egypt.

When the trade routes were later extended into the Mediterranean basin, the Phoenicians became the first carriers by sea (*see* Phoenicians). As their power declined the Greeks succeeded them as traders. The Greeks are believed to have been the first to do away with barter and put commerce on a money basis.

Wherever there came a break in a trade route, as for example, where goods were transferred from "ship

of the desert" to ship of the sea, a depot was established. These depots or posts grew into commercial cities. Such were Antioch, Smyrna, Tyre, Carthage, Massalia (modern Marseilles), Gadir (modern Cadiz), Corinth, and Palmyra. Early in the history of trade between Europe and Asia, Constantinople became important because of its position at one of the world's chief crossroads between the two continents.

Trade in the Middle Ages

Venice was founded in the 5th century A.D. both for defense and for trade, when the barbarian invasions menaced Rome. It became the greatest commercial city of the Middle Ages. Through its warehouses passed rich cargoes from China and India, which thence were distributed by pack trains over Alpine passes down into the plains of Germany and Flanders, or were carried in Venetian vessels to the Atlantic ports of France, England, and the Netherlands. Genoa, the most formidable rival of Venice, sent traders to the East, and planted colonies as far away as the shores of the Black Sea. Vienna got its start as a trading post in the commerce which came from the Black Sea up the Danube. Another important trade route extended from the Black Sea, by the Dnieper and Vistula rivers to the Baltic. A chief commodity in this trade was the famous Baltic amber.

During the Middle Ages a number of trading towns, such as Lübeck, Hamburg, and Bremen arose along the shores of the Baltic and the North Sea. For the protection of their business they organized a coöperative association which came to be known as the Hanseatic League (German *Hansa* means trade). It had a string of depots from the heart of Russia to London, sent out its own commercial agents, had its own bankers, and even maintained its own navy. (*See* Hanseatic League.)

The fairs of the medieval period had an importance in the narrow dull life of that time which we today can little appreciate. They were powerful stimulants to commerce, setting fashions and arousing demand. (*See* Fairs and Expositions.) The Crusades, too, had a great influence, by introducing Eastern products into the West (*see* Crusades).

For centuries Eastern commodities flowed into Europe by three principal routes. The northern crossed the deserts of central Asia, touching the great cities of Kashgar and Samarkand, and ran on to the Caspian Sea. There the way branched, one line passing southwestward to the Mediterranean, the other around the north end of the sea to Constantinople. The middle route was from western India by way of the Persian Gulf to Basra and Baghdad. From Baghdad the route was by caravan to Damascus and the ports of the Mediterranean. The southern route was by sea. Chinese junks gathered the products of the Far East and brought them to Malacca at the end of the Malay Peninsula. There Arab traders loaded them in their long low craft, and coasted around India to the Malabar shore, where they picked up goods that had been gathered at this point from Ceylon and the eastern part of India. Crossing the Arabian Sea and the Red Sea, the route led to Egypt and then to Italy.

The Commercial Revolution

Then came a vast change. Beginning in the 15th century, commerce grew so enormously and brought about so many changes in human life that the period from 1400 to about 1770 is often termed the "Commercial Revolution." In those three and a half centuries, commerce developed from a limited trade in luxuries into a world-wide exchange of goods useful to millions of people. It opened new continents; built new nations, and created empires.

This trade expansion was a part of the movement we call the Renaissance (*see* Renaissance). Two factors contributed especially to it. First, feudalism, with its restraints on trade, gave way to strong central governments which built up trade by giving privileges and protection to merchants. Second, daring explorations for new routes to the Indies—made possible by improvements in ships and navigation—opened new realms to commerce. Venturing out upon the unknown ocean, Columbus discovered the New World. Six years later Vasco da Gama found an ocean route to the Indies.

At last men had conquered the ocean. This conquest freed commerce from the bonds of inland and coastal routes, and it swept command of trade into the hands of nations on the Atlantic seaboard. Portugal seized the Indies trade; and Spain, France, and England sought the treasures of the New World. Over the ocean lanes sailed ships large enough to carry bulky, cheap cargoes, bringing new foods and supplies to Europe. From the East came tea and cotton; from the Americas, sugar, tobacco, corn, cocoa, furs, and fish.

This ocean trade, with its long voyages and large quantities of goods, swiftly created new ways of doing business. National money systems replaced the many local coinages, and the use of credit expanded rapidly. Men learned that combining their finances enabled them to trade on a larger scale than they could individually, and so they formed "joint stock companies," the origin of our modern corporations (*see* Stocks and Bonds). These led to the powerful "chartered companies." Some of these great companies, which were granted royal charters and exclusive trading rights, colonized parts of the Indies and the New World, and built the foundations of modern empires (*see* East Indies; Hudson's Bay Company).

By rousing more and more people to new wants and thus creating a "mass market," this Commercial Revolution prepared the way for the Industrial Revolution (*see* Industrial Revolution).

The Mercantile System

During the 17th and 18th centuries, most nations sought to build up their commercial power by the "mercantile system." Mercantilism was the outgrowth of the "bullionist theory," which declared that gold was the real wealth and power of a nation. The way to build up a stock of gold was to maintain a "favorable balance of trade"—that is, the nation should sell more than it bought. The most valuable exports, said mer-

cantilists, were manufactures. Each nation, therefore, strove to expand its home industries. To avoid buying from other countries, each aimed to develop colonies as sources of raw materials; and, to assure a market for its manufactures, it restricted colonial manufacturing. To keep money from flowing out for foreign manufactures, tariff barriers were raised. This "favorable balance of trade" theory was fallacious, for it was based on the expansion of exports and the restriction of imports, and ignored the value of "invisible items." England's insistence on these narrow principles helped to bring on the American Revolution (*see* Revolution, American; American Colonies).

Beginnings of United States Trade

In gaining their independence, the Americans temporarily lost their chief market, England. But, with characteristic energy, they built a large merchant marine and developed a rich trade with continental Europe and the Far East. During the European wars that followed the French Revolution, the United States became a leading supplier to the warring nations. Moreover, as the chief neutral, it gained a large share of the carrying trade. But this prosperity was soon shattered by the Napoleonic wars. Both the French and the British proclaimed blockades to shut each other off from American supplies. This crippled the nation's commerce, and finally helped to force it into war with England (*see* War of 1812).

After the war, American seamen again built up a great carrying trade, and the opening of rich farm lands in the West increased exports. Development of the famed "Yankee clippers," about 1840, gave the United States an enormous advantage in carrying, particularly in the Far Eastern trade. No other sailing ships could match the speed of the sharp-prowed clippers with their enormous spreads of sail. But in the latter half of the 19th century steamships came into use and, as American shipbuilders were slow to change from sail to steam, the merchant marine steadily declined (*see* Ships).

Another factor in this decline was the Civil War. In the four years of the war the merchant fleet was cut almost in half. Nor did the end of the war restore the fleet. For the next two decades the United States was concerned almost wholly with internal development. Industries which had sprung up during the war to meet the needs of the Union army spread rapidly under the impetus of inventions and the forceful methods of "big business." An ever-growing stream of immigration from Europe swelled the population, and the widening fan of railroads soon brought every corner of this huge home market into reach of producing centers. Because industrial enterprises were more profitable than the carrying trade, shipbuilding fell until nearly all exports were carried in foreign vessels.

United States Seeks Foreign Markets

Toward the end of the century, however, two developments again turned the United States toward world markets. First, the use of more efficient machines in industry and agriculture enabled the country to produce such a vast quantity of goods that new markets were needed. Second, the Spanish-American War in 1898 thrust the United States into international affairs, and so drew it from its self-contained isolation.

With this expansion of markets, the trade of the United States grew fast. By the early years of the 20th century, the nation had become one of the leading export countries, selling almost one-tenth of its goods abroad. This amount was increased enormously by the first World War, for then the United States became the chief supplier to the Allies.

After the war, the foreign trade of all countries fell rapidly as one market after another dropped away. This loss of markets was due chiefly to a revival of some of the principles of mercantilism. Impoverished by the war, most European countries tried to build themselves up by becoming as nearly self-sustaining as possible. Each tried to increase exports and cut imports. With nearly every nation thus closing its market to other nations, there was a vast decline in the international movement of goods. Unemployment and depression followed throughout the world. Thus it was demonstrated that the world had become, by the 20th century, an economic unit. Since the Commercial and Industrial Revolutions, nations have become so interdependent that a disturbed condition anywhere is felt throughout the world.

The second World War left most of the European nations, victors and vanquished alike, with their people impoverished and their production facilities crippled. To help rehabilitation, the United States set up the European Recovery Program in 1948. This furnished credit to participating countries so they could purchase factory equipment, farm machinery, and other goods needed to restore production. The program resulted in a greatly increased flow of trade, first from the United States and then among the European nations, as their economies improved. (*See also* International Trade; Truman.)

Work of the Department of Commerce

To help their merchants get markets, most nations maintain special bureaus or departments. The United States has had a Department of Commerce since 1903, and in 1913 set up a Bureau of Foreign and Domestic Commerce within the department. The Foreign Service of the Department of State gathers commercial and economic information under the direction of this bureau. Commercial treaties, negotiated by the Department of State, provide for reciprocal trade favors.

World Trade Routes

World markets—the chief regions of raw materials and of manufacturing industries—are linked by a network of ocean trade routes. The most-traveled is the North Atlantic route between Europe and the United States. Next busiest, threading from the Atlantic through the Strait of Gibraltar, is the Mediterranean-Indian Ocean route to Australia and the Orient. This is made possible by the Suez Canal (*see* Suez Canal). Construction of the Panama Canal created direct routes from Europe and the United States to the west coast of South America (*see* Panama Canal). From the Pacific coast, the Great Circle route and the Hawaiian Islands route lead to the Far East.

TRANSFORMER. All electric power lines which furnish electricity to homes, factories, and offices are equipped with black metal boxes, usually hung on the poles. The boxes contain *transformers.* These devices reduce the high voltage of the power line, usually about 2,400 volts, to a level that is safe for public use, usually 120 volts.

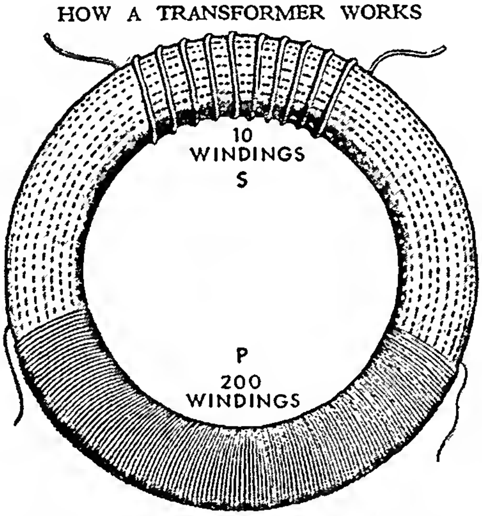
A transformer works by *electromagnetic induction.* As told in the article on Electricity, a changing electric current creates changing fields of magnetic force in the space around the wire carrying the current. If the changing magnetic fields sweep across another wire, they generate—that is, *induce*—electric current in it. If each wire is wound into a coil, and the coils are mounted on a common iron core, the inductive effect is greatly intensified.

This phenomenon of induction is used in transformers. The iron core may be a ring or a rectangle, and the coils are wound around it. The generating coil (called the *primary*) carries alternating current from the power line. The coil in which the current is induced (the *secondary*) is connected to the building to be served.

The currents in each coil are related by a simple rule. The total *power* (voltage times amperage) remains the same, except for a small amount lost in heat. The voltage and amperage are changed according to the ratio of the number of turns in each coil.

If the secondary has more turns than the primary, the induced voltage will be increased. If it has fewer turns, the voltage is decreased. Since the power in the two currents is the same, the amperage changes oppositely to the voltage. It decreases when the voltage increases and increases when the voltage decreases. A transformer of the first type is called a *step-up* transformer. One of the second type is a *step-down* transformer.

HOW A TRANSFORMER WORKS



Suppose a primary circuit (P) with 200 turns of wire is carrying a current of 1 ampere under electromotive force of 2,000 volts. The *power* (voltage × amperage) is 2,000 × 1, or 2,000 watts. Current of the same power (except for heat losses) will be generated in the secondary circuit (S) with 10 turns. But voltage will be *decreased* and amperage *increased* in the same ratio as that between the number of turns. Since the ratio is 200 to 10, the secondary voltage will be 100, and the amperage 20, except for losses caused by heating of the transformer.

Transformers have many uses other than in electric power transmission. Almost every radio set has them. One type, called an *air-core* transformer, has no iron core. It is used for extremely high-frequency (*radio-frequency*) current, since iron would slow down its action. Iron-core transformers are used for slower *audio* frequencies. (*See also* Radio.)

Devices similar to transformers are *induction coils,* such as an automobile spark coil. It uses direct current from the battery. The primary circuit is opened and closed by a cam in the distributor. This gives the changes needed to create changing magnetic fields and induces high tension current in the secondary for making sparks in the motor (*see* Automobile).

TRANS-JORDAN, OR JORDAN. Jordan is a small Arab kingdom in the western part of Palestine. Until 1949 it occupied only the land east of the Jordan River and was called Trans-Jordan ("across the river"). During the Arab war against Israel, Trans-Jordan troops occupied Arab Palestine, west of the Jordan. In 1950 its parliament declared the two sides of Jordan to be one state, the Hashimite Kingdom of Jordan. The annexation increased Jordan's population, from 466,833 (1948 est.) to 1,250,000 (1950 est.), and increased its area from 34,740 to 36,340 square miles. (*See also* Palestine; Israel.)

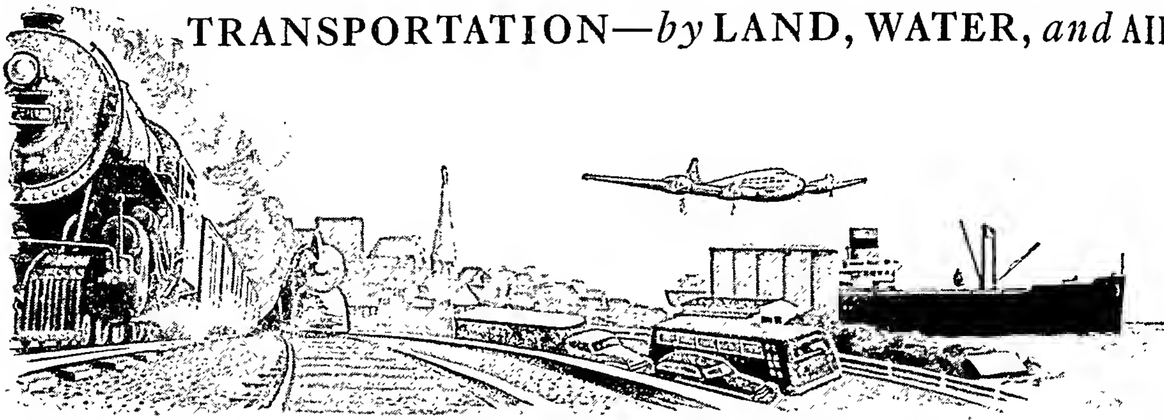
The more fertile areas are in the west. Here the peasants (called *fellahin*) grow wheat, barley, tobacco, and grapes. In the drier east, Bedouins pasture sheep, goats, and camels. Potash is obtained from the Dead Sea, and phosphate deposits are being developed.

The capital is Amman, 30 miles east of the Jordan. The only port is Aqaba on the Red Sea, a strategic point where Jordan, Israel, Egypt, and Saudi Arabia meet. The Cairo-Baghdad air route passes through Amman. A pipe line carries oil across the country from Iraq to Israel.

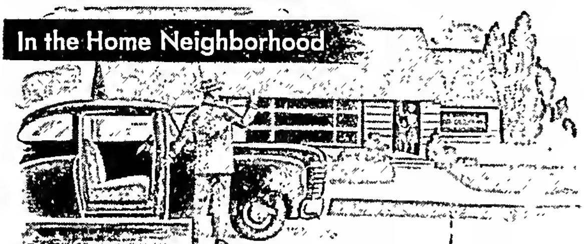
Although Jordan is new as a nation, the region has a long history. Until after the first World War it formed a part of Palestine. The Jordan region includes the Biblical lands of Edom and Moab. Amman, as Rabbath-Ammon, was in existence when Moses led the Israelites to the Promised Land. In the 3d century B.C. Ptolemy Philadelphus rebuilt the city and named it Philadelphia. Petra was an old city when the Romans conquered and rebuilt it. Kerak was a stronghold of the Crusaders.

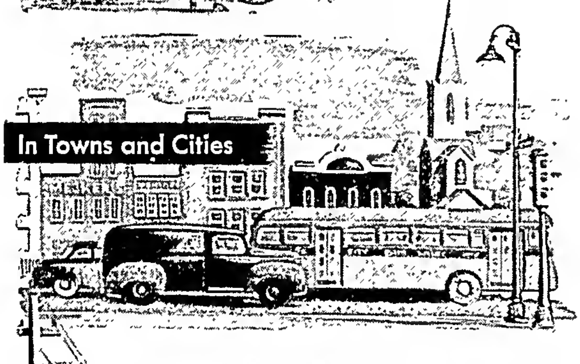
The Arabs conquered this region in the 7th century and held it until the Turks gained control in 1516. In the first World War the British conquered it, and it became part of the British mandate over Palestine. But in 1921, under British tutelage, a separate administration was set up for Trans-Jordan, with Amir Abdullah Ibn Hussein at its head. In 1946 Britain recognized Trans-Jordan as an independent nation, with Abdullah as king. When the Jews created Israel in 1948 Jordan's British-trained legion led an Arab invasion (*see* Israel). In 1950 Jordan annexed the Arab part of Palestine, including the old sector of Jerusalem. Israel did not recognize the annexation. Abdullah was assassinated in 1951. In 1952 Jordan got American aid for agriculture and education. British-educated, 18-year-old Hussein I became king in 1953. In 1954 Jordan and Israel submitted their border disputes to the United Nations.

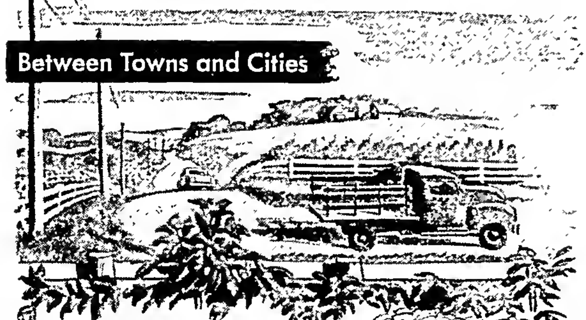
TRANSPORTATION—*by* LAND, WATER, *and* AIR



Railroad trains, ships, trucks, and airplanes bring things to eat, wear, and use from all over the world. Transportation also takes people wherever they want to go. If we did not have good transportation we would have to live as the pioneers or the Indians.







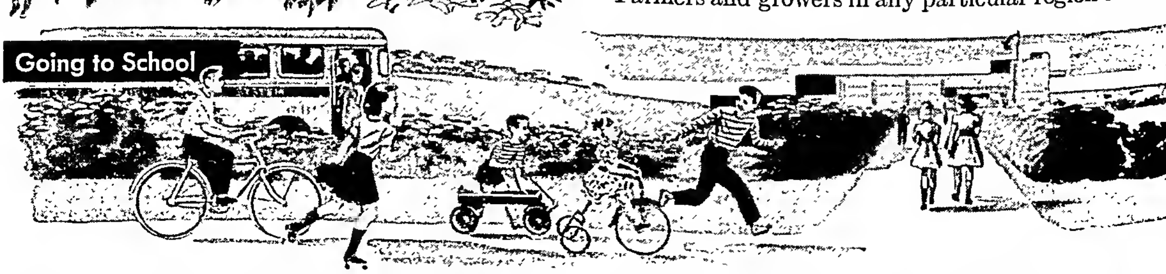
TRANSPORTATION. Without modern transportation no one in the United States could live the way he does. Hardly anyone grows all his own food, makes all his own clothes, and builds his own house out of what he can find near by. Almost everything we need for modern living is brought to us, often from great distances. The same is true of people in any other highly developed country.

Foods, clothes, building materials, and other things we need must often travel long distances before we buy them. Bananas and coffee, for example, grow only in tropical lands. Steamships bring these things across wide oceans and then railroad trains and trucks carry them to all parts of the country. The clothes we wear may have been made in factories hundreds of miles away. The house we live in is made of many different materials. All these had to be brought together in one place before the house could be built. Present-day mail service likewise depends on good transportation.

Transportation Makes Living Easier

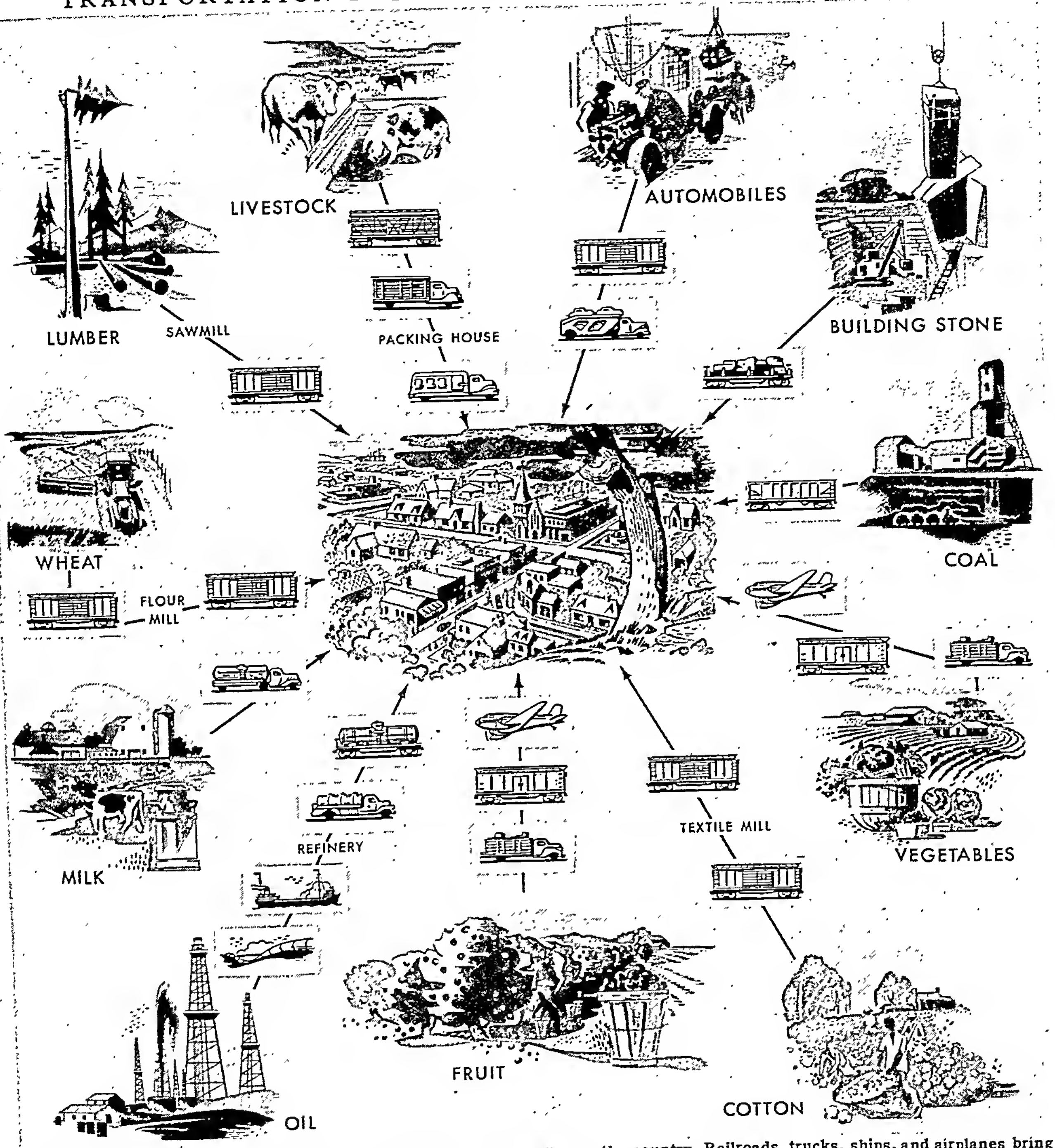
Without good transportation we would have to live as the early pioneers did. Pioneer families grew or made almost everything they needed. But their lives were hard and they spent most of their time just getting enough to live.

Today families do not have to get everything they need from a small near-by area, as the pioneers did. Good transportation makes it possible for them to use the products of farms, factories, and mills located hundreds or even thousands of miles away. Farmers and growers in any particular region can raise



These pictures show how transportation helps us every day. People use automobiles for going to work, to stores and movies, and for trips. In towns and cities many people ride busses, and trucks deliver goods. Railroads, automobiles, busses, and trucks carry people and freight between cities. Many children walk to school, but others use bicycles or busses.

TRANSPORTATION BRINGS SUPPLIES FROM EVERYWHERE



This drawing shows how a typical community gets supplies from all over the country. Railroads, trucks, ships, and airplanes bring food, materials for clothing, and materials for building homes. Without modern transportation, the people would have to get along on what they could find near by.

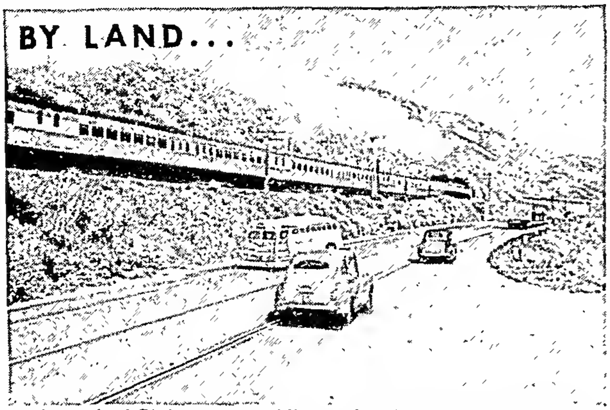
just what grows best there. Then they can send their products wherever they are needed.

Manufacturers can also ship their products to markets in distant regions. For that reason, factories and mills can often be built in favorable locations where power and raw materials are available and where there are plenty of workers. Thus their goods can be produced at lower cost.

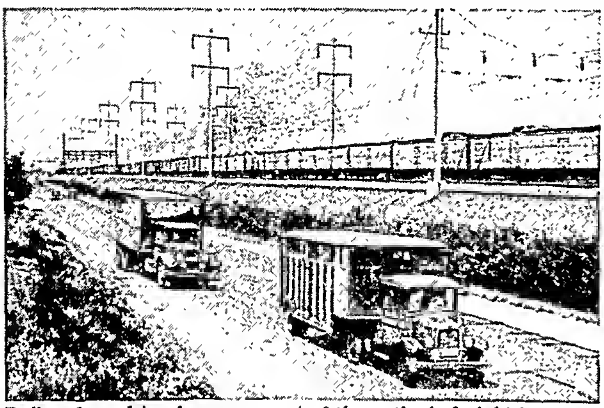
Today people can travel much more easily than the pioneers could. Present-day methods of transportation make it possible for families to travel long distances on their vacations. Businessmen and salesmen can travel easily to distant cities. When people are in a hurry they can get almost anywhere in the United States by airplane.

Cities can exist only because of good transportation. City land is largely covered with buildings, and few raw materials of any kind are available. So city dwellers could not possibly produce their own food, clothes, and shelter. Every day countless tons of

THREE GREAT KINDS OF TRANSPORTATION



In the United States, automobiles and railroads provide most of the land transportation for people, except in large cities.



Railroads and trucks carry most of the nation's freight between localities. Trucks do the hauling within towns and cities.

needed goods pour into a big city by many kinds of transportation. If these supply lines should ever fail completely, everyone would have to move out of the city in order to live. The huge transportation system of the United States is thus even more important to city dwellers than to others.

Transportation in the United States

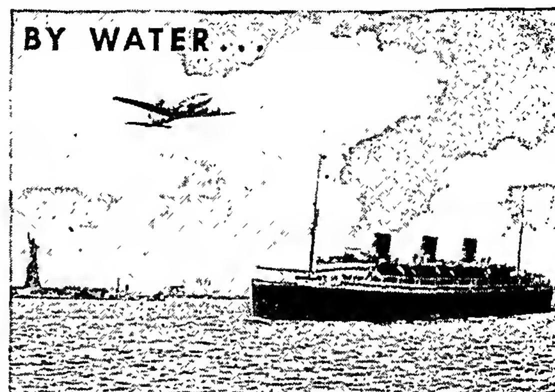
A TRANSPORTATION system consists of all the different things that help carry people and goods from place to place. It includes all the motor vehicles, such as automobiles, busses, and trucks; all the locomotives and railroad cars; all the ships; and all the airplanes in the country. It also includes all the railroad tracks, highways, and city streets; all the railroad and bus stations; all the freight yards and truck terminals; all the harbors and airports. The transportation system of the United States is the largest in the world.

Commercial transportation, the business of carrying freight and passengers for money, is a huge industry in itself. More than 5½ million workers in the United States are employed by the transportation industry as a whole. Nearly 2½ million work for public transportation lines, or *common carriers*, as they are called. These lines ship goods for anyone who pays the freight charges and carry any passenger who pays the fare. More than 3 million people work in the business of private trucking. Commercial transportation is one of the world's biggest industries.

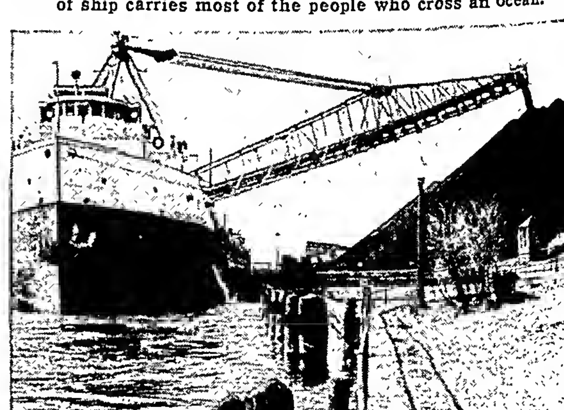
Passenger Transportation by Automobile

Yet commercial transportation is only part of the whole transportation system. There are more than 40 million private automobiles in the United States—about one-fourth as many cars as people. Americans do more traveling by private automobile than by any other means. When they go from one town to another, nearly three out of four travel by automobile. Even within cities and towns, a large proportion of wage earners drive their own cars to and from work.

People like automobile transportation for many reasons. A driver can start whenever he wants to and can take any route he pleases. He can get to many localities that are not served by railroads or bus lines.



Here a fast ocean liner is entering New York harbor. This kind of ship carries most of the people who cross an ocean.



Cargo vessels carry freight at very low cost, wherever there are good waterways. This Great Lakes steamer is unloading coal.

Automobile travel is also cheap, especially when a whole family goes on a trip.

Automobiles do not carry all the nation's passenger traffic, however. It is a good thing that they do not. Lack of adequate parking space is a serious problem in almost all big cities. And many of the country's highways are badly overcrowded during part of each year. There will always be a need for public passenger transportation.

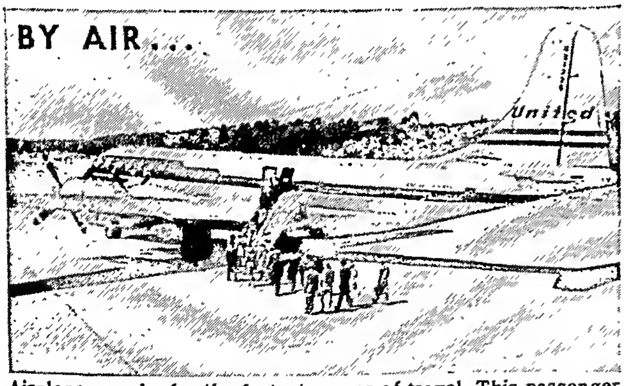
Public Passenger Transportation

In most cities and towns, this need is met by busses and streetcars. These vehicles carry from 20 to 60

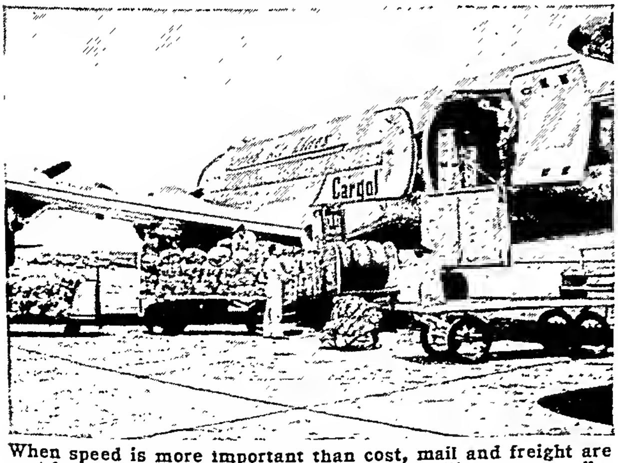
or more passengers comfortably. They run on regular routes, stopping to pick up passengers or to let them off. In the largest cities, hundreds of thousands of people go to and from their work in business and manufacturing districts. The streets would be choked with traffic if all these people traveled by bus, streetcar, and automobile. Therefore these cities have elevated railways or subways.

Many Americans ride cross-country busses between cities and towns. On an average, however, people travel about one twentieth as many miles by bus as they do by automobile. Railroads are the principal common carriers between cities and towns. A railroad train can carry hundreds of people much faster than busses or automobiles could safely do. Some modern trains on main-line tracks can maintain speeds of 80 or 90 miles an hour between stops. People in the United States travel about one tenth as many miles by railroad as they do by automobile.

When the country was young, Americans traveled a great deal by water. There were few roads in those days, and so rivers and canals offered the only easy way of getting from one town to another. Now railroads and highways connect a community with almost every other place in the country. Water travel is slow, and for that reason few people today take lake, river, or coastal steamers except for vacation trips. But most people who travel across the oceans to other countries go by steamship.



Airplanes are by far the fastest means of travel. This passenger plane can cruise at more than 300 miles an hour.



When speed is more important than cost, mail and freight are sent by air. This plane has big doors for handling cargo easily.

Commercial air travel is the youngest and fastest means of transportation. Today gleaming air liners can rush their passengers across the United States in an overnight trip. Air travel still accounts for only a small fraction of the total passenger traffic. But each year more and more people travel by plane.

Many Kinds of Freight Transportation

In passenger transportation the greatest demands are for speed, comfort, and safety. In freight transportation the main demand is ability to move heavy loads at the lowest possible cost. Freight carriers are designed with this need in mind.

The most important freight carriers in a community are trucks. Light delivery trucks are used to carry loads to homes. Heavy trucks with special bodies are used for bulky loads such as coal, oil, or building materials. Small items may be delivered short distances by bicycle or motorcycle.

But delivery to homes is just the last step in a long chain of transportation. Only a small number of the things people use are produced in the communities where they live. The rest must be hauled from where they are produced, often over long distances. For this long-distance hauling the railroads are the most important carriers.

Railroads carry more than twice as much freight as all other carriers put together. Freight cars can carry loads that would be far too heavy for any truck. A single train can carry many thousands of tons of freight; and on clear track it can roll along steadily, hour after hour, as a truck cannot.

The great disadvantage of railroads is that tracks cannot be laid to every point at which freight is shipped or received. For door-to-door delivery, freight must often be carried part of the way by trucks. So shippers sometimes prefer to send goods all the way by truck, even for long distances.

If a shipper must send freight by the fastest possible method, he will choose air express or air freight. Swift cargo planes carry a great deal of highly perishable freight, such as flowers, delicate fruit, or baby chicks. This is an expensive way to ship freight, and so shippers send bulky goods by air only when they need to insure quick delivery.

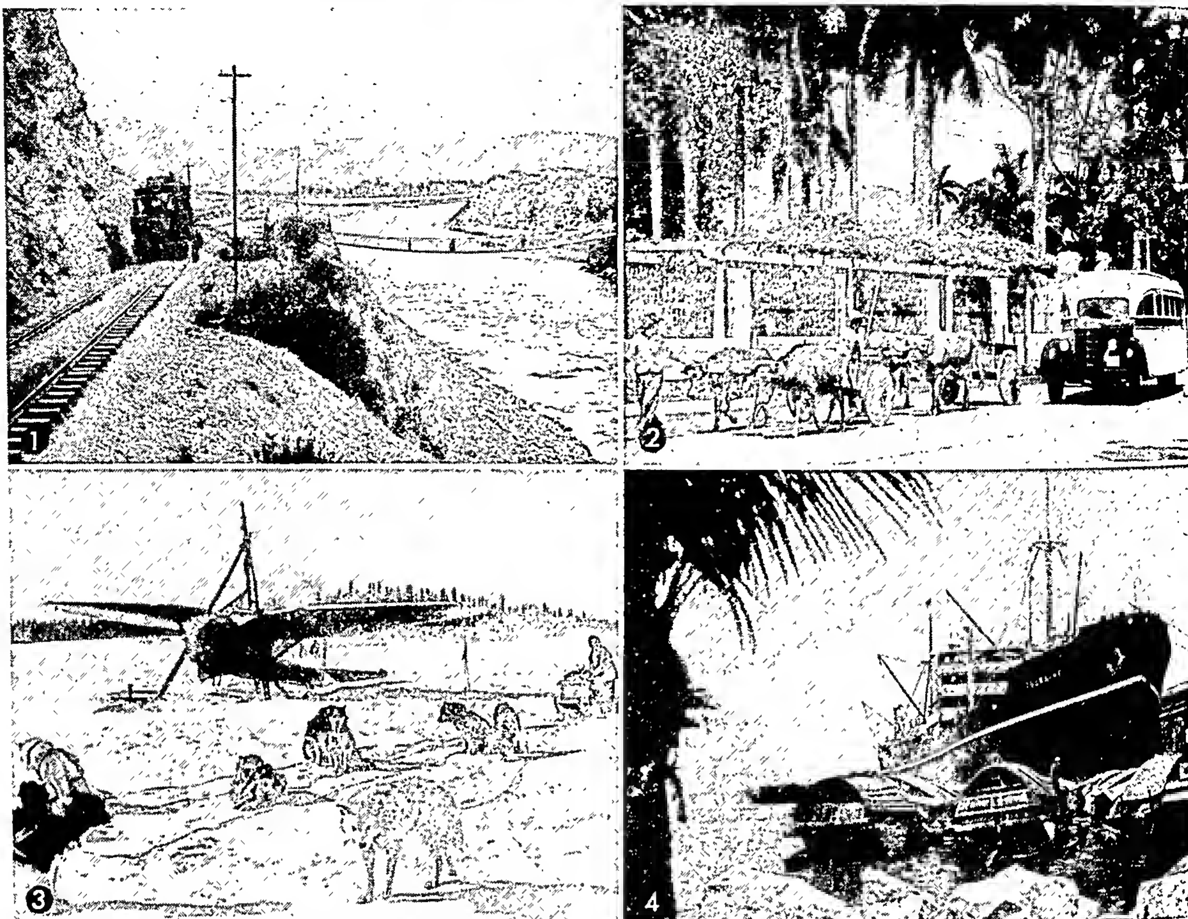
If speed is no object, heavy shipments are sent by water wherever possible. The United States has many good inland waterways. Communities on its Great Lakes and rivers are fortunate, for they can receive shipments of *bulk freight*—coal, grain, and ore—by the cheapest of all methods. Steamships and barges carry more than one-seventh of the nation's freight.

One very specialized kind of land transportation is the pipe line. A network of steel pipes connects the major oil fields of the United States with refining and shipping centers. Oil sent through these lines accounts for more than one-tenth of all the freight shipped in the United States. Similar pipe lines carry natural gas to cities where it is used.

Providing Terminals and "Ways"

For all kinds of transportation, *terminal facilities* must be provided at either end of a line. Passengers

OLD CONTRASTS WITH NEW IN MANY LANDS



Modern kinds of transportation have not replaced more primitive ones in many lands. 1. Here burros plod across a rope bridge in Peru while a railroad train climbs along a track leading up the valley. 2. In modern San José, the capital of Costa Rica, oxcarts driven by barefoot farmers share the road with light busses. 3. Both airplanes and sledge dogs are used for crossing the wastelands of the Canadian Arctic. 4. In the harbor at Manila, native sampans lie alongside a modern freighter.

taking trains or busses must have some place to buy tickets and to check their baggage. Airplanes need long, level areas for landing and for taking off; and their passengers too must be provided for. Freight trains and trucks must be able to stop at convenient places for taking on freight or unloading it. And ships need harbors where they can lie sheltered from storms and where they can load and unload. All these facilities form an important part of the transportation system.

Wheeled transportation on land differs from water and air transportation in one important respect: a "way" must be provided. Automobiles, railroad trains, trucks, and busses must have a smooth, hard, nearly level surface to roll on. So good roads and streets must be built for motor vehicles, and tracks must be laid for railroad trains. But before a new road or railway line can be built, a strip of land called the *right of way* must be acquired, sometimes at heavy cost. In a big country the expense of providing and maintaining roads, streets, and railroads is tremendous.

Before steam railroads were developed, many canals were dug across wide land areas. These helped in moving heavy loads because horses or mules could pull much more in canal boats than they could in wagons. Today such canals are still widely used in Europe, but in the United States railroads and highways have largely replaced them. Most canals in America are ship canals which connect open waterways with one another. (For charts and further facts on United States transportation, *see* United States.)

Transportation in Other Lands

PEOPLE in the United States often think of railroads, automobiles, trucks, busses, steamships, and airplanes as the only kinds of transportation. This is almost true in the United States and in other highly developed countries. But in some lands one or more of these transportation means are almost unknown. And the people of these lands may use methods of transportation that Americans have never seen.

The kinds of transportation used in any region depend partly on the nature of the land and the climate. In some countries high mountains form a barrier to transportation, and in others swamps must be crossed. In one land snow and ice are an important obstacle and in another desert heat must be met. In each case

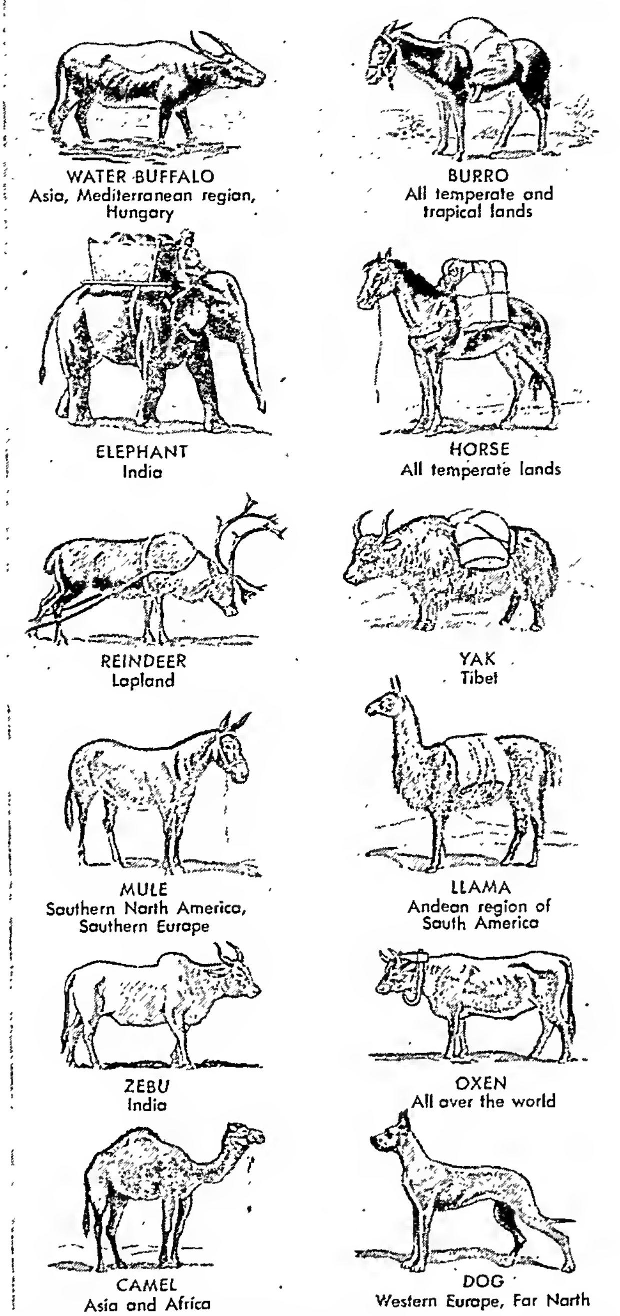
the particular kind of transportation used must be adapted to meet these conditions.

The kind of transportation also depends on the resources of a region and on the development of business and industry. Some regions have minerals or other valuable resources that will repay the cost of providing transportation to get them. Others offer nothing that would justify the expense of building roads or railroads. Except in cities, railroads are rarely built to carry passengers alone. Freight must be available, or the railroad cannot earn enough to repay the cost of construction. If a nation wants a railroad in unsettled country for military reasons or to help develop the region, it must pay all or part of the cost of building it.

Special Kinds of Transportation

In a country where natural obstacles are too great or where there are few resources, transportation often remains primitive. Men may carry loads on their own backs or they may use animals to carry burdens for them. Such *beasts of burden* offer the only means of transportation in many regions.

ANIMALS CARRY BURDENS FOR MEN



All over the world men still harness animals to pull burdens or place the loads on the animals' backs. Here are some important beasts of burden used in different parts of the world.

The most familiar beasts of burden are horses, burros, mules, and oxen. Burros are also called asses or donkeys. The mule is a cross between a horse and a burro. All these animals can stand a variety of climates and so are widely used. Even in highly developed countries they often serve as work animals and beasts of burden because they cost less than tractors or motor vehicles.

In many places particular native animals are used because they are well adapted to conditions in the region. Arabian camels, for example, can go without water for several days at a time, and their feet are specially formed for walking on sand. So these animals are ideal for carrying burdens on the hot, sandy deserts of Arabia and Africa. Their cousins, the llamas of South America, are sure-footed and able to stand thin air at high altitudes. These qualities suit them for use in the Andes Mountains. The long hairy coats of yaks make them good carriers and work animals in the cold regions of Tibet, and the sturdiness of reindeer fit them for use in Arctic regions.

Contrasts in Transportation

As the resources of a region are opened up and industry develops, transportation changes. For a long time, older, primitive methods of transportation may be used alongside newer, mechanized means. The Andean region of South America has valuable mineral deposits, and railroads have been built at great expense to reach them. Away from the railroads, llamas still carry freight up the steep mountain trails. Since airplanes can fly over mountains, they are also used for carrying freight and passengers.

On the Sahara Desert in Africa, trucks with wide tires and special cooling systems prove useful for moving freight. But camel caravans still cross this sandy wasteland as they did centuries ago. Here too airplanes simplify the problem of crossing a great natural barrier.

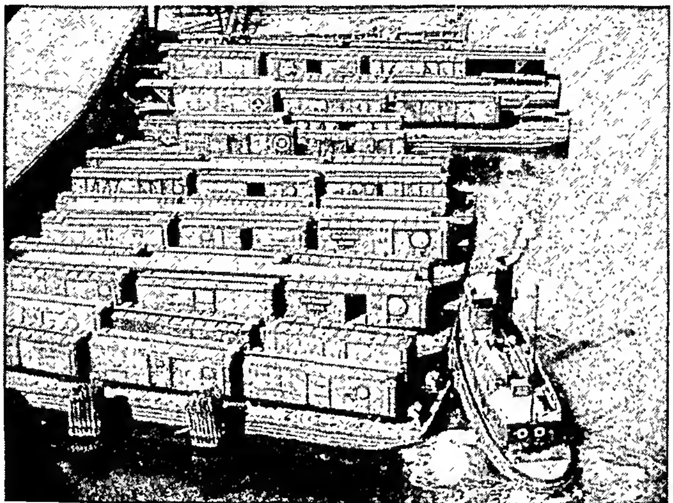
Even in undeveloped lands, both old and new methods may be used. In Antarctica, explorers have always used sledges drawn by teams of sturdy dogs. Now in addition to dogs, they may use tractors with special treads for traveling over snow and ice. And for long, fast trips of exploration they use airplanes, fitted with skis for taking off and landing. In swamplands all over the world, men use canoes or flat-bottomed, square-ended punts for getting about. Now, especially in the Southern United States, they also make use of "swamp buggies," flat boats driven by an engine and airplane propeller.

How Transportation Helped to Build Civilization

MANKIND'S progress toward better living has always been linked to transportation. Cities could not grow except as men could bring supplies from greater and greater distances. Manufacturing could not improve above the level of handicrafts until supplies could be moved cheaply in large quantities. And wealth could not increase above a certain level until improved manufacturing methods reduced the cost and labor of producing goods.

For untold ages, men carried all loads on their own backs or dragged them on sledges. Then they tamed certain wild animals and used them as pack animals for carrying burdens. They also invented the wheel which made pulling loads much easier. And they learned to build boats and ships which could carry people and heavy burdens as well. They put sails on their ships and eventually came to depend only on them. But modern transportation was not born until men learned to use the power of steam and gas engines.

NEW YORK CITY FREIGHT COMES BY WATER

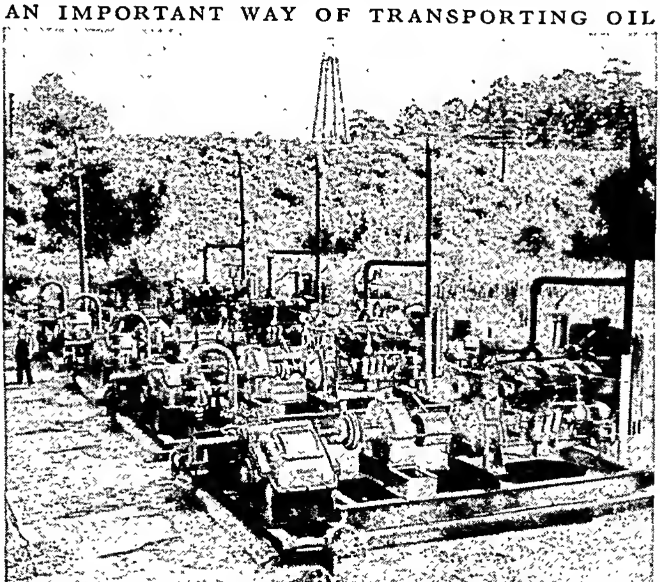


Only two railroads bring freight cars on rails to the island of Manhattan. Other lines bring cars on floats, as shown here.

Improvements in Land Transportation

By about 15000 B.C., primitive tribes in the Near East had tamed wild cattle. Ancient farming people taught them to carry loads and to draw carts. Records in Egyptian tombs show that oxen and donkeys were used in these ways at least as early as 2700 B.C. Horses did not appear until later, and then they were used chiefly in war. About 2100 B.C. the people of Mesopotamia were using horses to draw their war chariots. They probably learned to use horses from the nomads far to the north. Horses were brought to Egypt about four centuries later, and from then on the pharaohs rode into battle in gleaming chariots. Not until much later were horses used for riding.

AN IMPORTANT WAY OF TRANSPORTING OIL



More than one-tenth of the freight moved in the United States travels not on wheels or in ships but through steel pipes. Here is a pumping station which forces oil through pipe lines to refining centers.

Other animals also were domesticated as beasts of burden in ancient times. The camel has been the "ship of the desert" for countless centuries. Hannibal, the great Carthaginian general, used elephants as cavalry animals in his wars with the Romans. These powerful beasts had probably been used as work animals long before then.

The wheel may have been invented in crude form as early as 10,000 years ago (*see* Wheel). The oldest wheeled vehicle known is a chariot discovered at Kish in Mesopotamia. It is thought to be about 5,500 years old.

Wheeled vehicles could not be really useful without good roads to roll on. So until the time of the Romans almost all long-distance hauling on land was done with help of pack animals.

Beginnings of Water Transportation

For carrying loads on water, however, men have had boats and ships since very early times. Primitive men probably first discovered that they could tie a load on a floating log and push it ahead of them as they swam a river. Later they learned how to hollow out a log into a rough sort of boat and to use rafts of inflated animal skins (*see* Boats; Canoes; Ships).

Early boats were doubtless pushed along with crude paddles. Later came sails and real oars. Great progress was made after men learned to build a boat out of many timbers instead of one single log. Use of this method permitted making vessels large enough to sail on the open ocean.

The earliest civilization developed along bays and rivers, with aid from water transportation. Very early, ships came into use on the Nile in Egypt and on the Tigris and Euphrates in Mesopotamia. The Sumerians

of Mesopotamia and the early Egyptians even ventured out upon the Red Sea and the Mediterranean. The Minoans in Crete developed a great civilization based upon sea-borne trade (*see* Aegean Civilization).

Ancient Dependence upon Ships

All later great civilizations in the ancient western world depended largely upon ships for supplies. The Phoenicians, Greeks, Carthaginians, and Romans all took to the sea (*see* Phoenicians).

Great cities such as Alexandria, Rome and Constantinople were fed in large part by bringing grain from Egypt and other fertile parts of North Africa by water. Away from the Mediterranean and the great river valleys, cities and towns were limited to the number of people that could be fed with supplies carried from the neighborhood.

When All Roads Led to Rome

The Romans were the only people of ancient times to realize the value of good roads. Roman roads were beautifully constructed of stone, rubble, and sometimes concrete (*see* Roads). They generally ran straight as an arrow to their destination. The Roman road engineers made cuts through high hills, bridged wide rivers, and built causeways through swamps to provide a level surface for the roads.

At the time of Julius Caesar's death in 44 B.C., excellent roads connected all important towns of Italy. By the time of the emperor Trajan about 150 years later, they ran through Gaul (modern France), Britain, and the provinces at the eastern end of the Mediterranean. These were primarily military roads, built so that the legions could march from place to place as quickly as possible. But anyone could use them, and merchants sent freight over them in heavy wagons and carts.

Medieval Setback in Transportation

After Roman power was broken in the west in the 5th century A.D., the great Roman roads fell into disrepair. Hauling by land almost ceased, except from farms to near-by towns. The standard of living sank, and old cities dwindled to towns or mere villages.

In countries bordering on the eastern Mediterranean, however, trade continued to flourish. The Eastern Empire, with its capital at Constantinople, remained strong for nearly 1,000 years after the fall of Rome, with its trading galleys and war galleys to protect the merchant vessels from pirates. Goods from the oriental countries poured into Constantinople over caravan routes (*see* Byzantine Empire).

Gradually Europe recovered and other cities began to trade by sea. The galleys of Venice, Genoa, and Florence carried much of the trade in the Mediterranean. Ships of the Hanseatic League of cities dominated trade in the North Sea area and the Baltic (*see* Hanseatic League).

Rise of the Sailing Ship

Toward the end of the Middle Ages, the first great improvement upon ancient ways came with development of sailing ships. Ancient vessels had used sails, but mariners had always relied mainly upon oars. Among the Phoenicians the rowers were free sailors who served for part of the profits of the voyage. In Roman times and later, prisoners were made to work at the oars as galley slaves.

Rowing was practical as long as voyages were short and supplies of water and food could be renewed frequently. But for long voyages such vessels were not economical because the necessary supplies took so much room that there was little space left for cargo. Therefore commercial nations improved the hulls and sails of their ships until sails alone could be relied upon to move the vessels. Very few men were needed to operate such a ship. By the time Columbus discovered America in 1492, sailing ships could cross every ocean of the world. With a sailing ship, virtually the only costs were for the ship itself, its cargo and supplies, and pay for a small crew.

This development brought great changes throughout the world. Europeans could draw upon the resources of the Americas, Africa, and Asia, and in turn sell their products to these other continents. Wealth and leadership passed from the Mediterranean nations and cities to nations which had fleets of sailing vessels for trade, and navies to protect merchant vessels.

First Improvements in Land Transportation

During the two centuries after the discovery of America, a few improvements in land transportation were made. No European nation met the most important need of all—good, hard-surfaced roads. But bridges were built, and "ways" were cleared by cutting back trees and underbrush, largely to get rid of hiding places for robbers. Henry IV of France planted rows of poplars along the principal roads to mark the way when heavy snow covered the ground.

Hauling costs were cut in some nations during the 1600's and 1700's. This was done by constructing canals and using animals walking alongside to tow barges. In this way, animals could pull much heavier loads than they could on the crude roads of the time. In the vicinity of coal mines horses were used to pull heavily loaded wagons on wooden rails.

Early Travel in North America

TRANSPORTATION was in this state of development when the first English colonies were founded in North America. The early colonists settled on the seacoasts and near the mouths of rivers emptying into the sea. There ships could link them to Europe. Until shortly before the American Revolution, the settlers used water routes wherever possible (*see* Rivers and Inland Waterways). Many types of small sailing ships took them along the coast and up the rivers that empty into the Atlantic Ocean. Big bargelike ferry boats were propelled by sails or pushed by poles in some of the Eastern colonies.

For inland travel the settlers adopted Indian ways. They saw the Indians make canoes of bark and animal skins and hollow out strong logs with fire for *dugouts* (*see* Canoes). The colonists copied all these methods: Light canoes could be carried overland (*portaged*) between two bodies of water. Forts grew up along these important portage routes and later many of these became inland towns.

On foot and by horse the settlers followed the Indian trails (*see* Pioneer Life). These trails were first made by animals in search of water, food, and often salt. The Indians followed the animal paths and made new ones of their own. Indian trails nearly always proved to be the best routes over the land, for almost always the animals had found the best ways over rough ground and the lowest passes through mountain ranges.

As the settlers felt the need for better transportation, they improved these paths and continued to do so as the country developed. One such path about 90 miles long linked Philadelphia and New York City. In 1675 men traveled over it on foot in three to five days. By 1775 fast horse-drawn coaches over an improved road made the trip in less than two days. About 60 years later the first railroad between these cities took the same path.

Toward the end of the 17th century wagons, carts, and stagecoaches began to carry freight and passengers among the little communities. But by 1761 there were still only 38 wheeled vehicles in Philadelphia. Some wealthy men were carried in boxlike *sedan chairs* by servants or horses.

In winter, travel was simple in the northern colonies. Horse-drawn passenger sleighs and freight sledges, as well as Indian dog sleds, could speed over the snow. Sleighs, in general use by 1700, allowed families to visit among the settlements at this one time of the year. Men on foot often used snowshoes.

Building the First Roads

The colonists built the first wagon roads to connect rivers and seaports. But travel over them was uncomfortable as well as unsafe. The dirt surfaces turned from blinding dust in summer to deep mud on wetter days. As more wheeled vehicles appeared, logs were laid side by side in the mud and driven down by heavy traffic. These bumpy surfaces came to be called *corduroy* roads. (*See also* Roads and Streets.)

Gradually the first crude roads were extended and connected more systematically. By 1775 a traveler could move over them all the way from Portsmouth, N. H., to Charleston, S. C. By this time regular stages also ran between the principal Eastern ports.

In 1794 the first *turnpike*, or toll road, was completed from Philadelphia to Lancaster. This was a *macadam* road of crushed rock. Named for its Scotch inventor, John MacAdam, it was one of the first of its kind in the world. Private companies built the turnpikes and collected fees, or *tolls*, from travelers. They also built and operated *toll bridges*. Rapid construction of turnpikes followed in the early 19th century (*see* Roads and Streets).

These American developments were patterned largely upon gains made in Britain and elsewhere in Europe. About the middle of the 18th century, the English began to construct great numbers of good hard roads radiating from London in all directions. With better roads, carriages became common. Many stagecoach lines were established. These operated on regular schedules, much as railroads and busses do today.

The stages were slow, however, and if a man were in a hurry he "traveled post." At the nearest posthouse, the traveler engaged a horse and rode it to the next posthouse along his route. There he exchanged his horse for a fresh mount and continued his journey. Such posthouses were established at intervals of a

THE FAST MAIL IN COLONIAL AMERICA

Riders like this young man carried mail between New York City and Philadelphia in colonial days. In 1764 they covered this distance of more than 90 miles in 24 hours. Travelers took two or three days by stagecoach.

AMERICAN TRANSPORTATION BEGINS IN EARLY COLONIAL DAYS

The earliest colonists in America came from England in small sailing ships. They brought Old World methods of transportation with them, using horses and mules as riding animals and beasts of burden. But they also learned much from the Indians who taught them how to use dogs to drag burdens, how to make burden frames for carrying loads on their backs, and how to build canoes.

few miles along all the principal roads (*post roads*) of England. By riding post, a man could cover more than 120 miles a day. On some roads, men who did not care to ride could hire a light carriage (called a *post chaise*) and change horses along the way.

Steamships and Canals

UNTIL after the American Revolution, transportation was sharply limited by the primitive kinds of power available. On land, motive power was provided by animals or men. At sea, the only source of power was the wind.

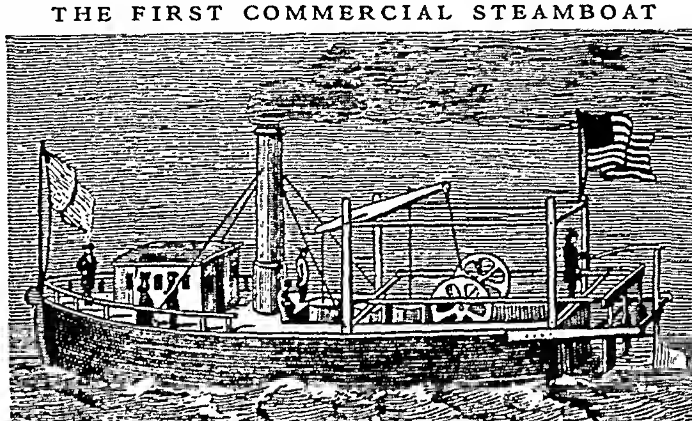
But during the 18th century, men had learned to use the power of steam in steam engines (*see* Steam Engine; Watt). Inventors dreamed of using this new source of power for transportation, both on land and on water. The challenge of water transportation was easier to meet. At that time engines and boilers were very heavy for the amount of power they produced. They could not easily pull their own weight on land in addition to a useful load. But a boat could support a heavy weight and could also be propelled with a small amount of power.

The first successes in using steam power for transportation came with steamboats. The American pioneer in using steam for water transportation was John Fitch. In 1786 he built a steamboat propelled by paddles. Another of his boats, on the Delaware River in 1790, was the first regular passenger steamer in America. But Fitch received little encouragement and he died without proving that steamboats were practical (*see* Fitch).

A few years later Robert Fulton, with the financial backing of wealthy friends, built a steamboat which could make good speed and earn a profit (*see* Fulton). On Aug. 7, 1807, his steamer *Clermont* left New York City for Albany and made the trip in 32 hours. Within a few years, large, powerful steamers were operating on the rivers, bays, and sounds of the Atlantic seaboard, and on the Great Lakes.

Fulton and his associates also placed steamers on the Ohio and Mississippi. But the somewhat deep hulls and keels of the vessels made them awkward in working around sand bars, mud flats, and snags in those waters. In 1816 Henry Shreve produced a more successful type by using a flat-bottomed, scowlike hull. Soon a large number of these steamboats were providing transportation over thousands of miles on all the larger rivers of the Mississippi system.

THE FIRST COMMERCIAL STEAMBOAT



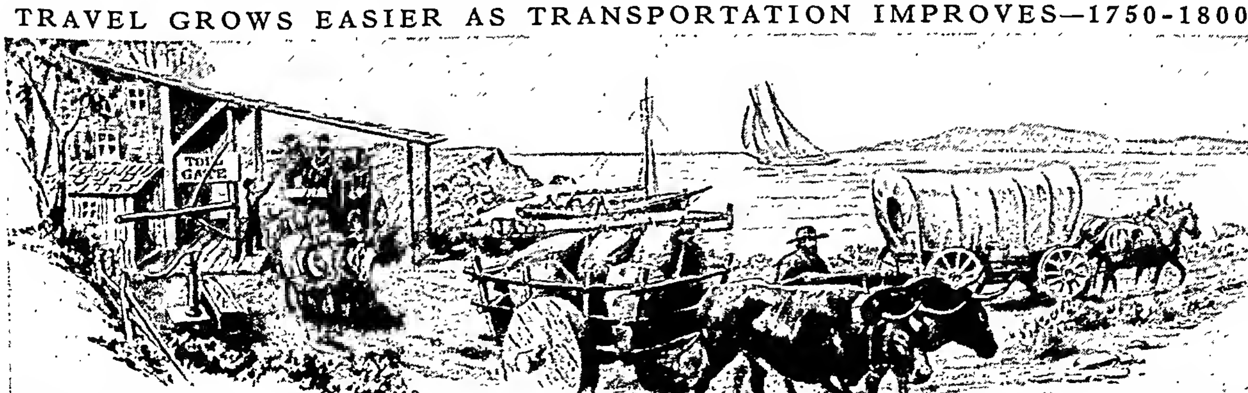
John Fitch of Philadelphia built this steamboat nearly 20 years before Fulton's *Clermont* steamed up the Hudson River. In 1790 Fitch's boat made regular runs to Trenton and other towns on the Delaware River.

Using steam on the oceans proved to be harder. The difficulty lay in carrying sufficient coal for the long voyages and in still having space for passengers and cargo. In 1819 the *Savannah* made the voyage from Savannah to Liverpool but used sail most of the way. Not until 1838 did vessels cross the Atlantic entirely with steam power. As late as 1854, swift American clipper ships were still the most economical carriers for many types of ocean-borne freight.

Opening the West with Canals

By the 1800's the country west of the Atlantic seaboard was settled enough to offer a great deal of traffic if good transportation were provided. The Federal government made one contribution by starting to build the Cumberland Road, or National Pike, westward from Cumberland, Md., in 1811. It was well built, with macadam pavement, and it carried a great volume of traffic in stagecoaches and wagons.

TRAVEL GROWS EASIER AS TRANSPORTATION IMPROVES—1750-1800

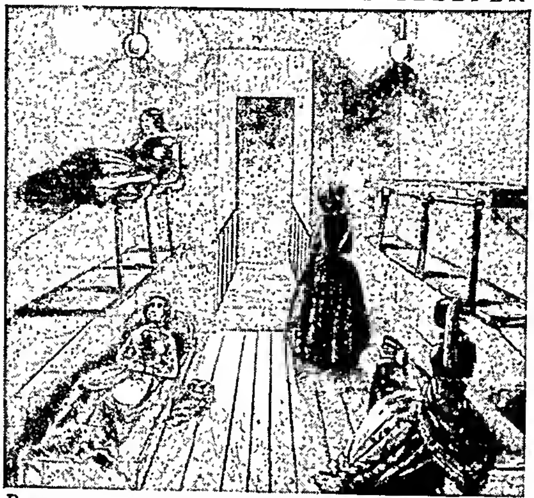


American transportation improved in late colonial and early federal days. Many small ships carried cargo and passengers up and down the coast. Some good roads were built; these had toll gates where travelers had to pay a fee for use of the road. Farmers carried some of their goods to market in oxcarts. For shipping freight long distances overland, Conestoga wagons were used.

Canals helped even more. The great era of canal building began in 1817, when Governor Clinton of New York started construction on the Erie Canal from the Hudson at Albany to Buffalo on Lake Erie. "Clinton's Ditch," as it was called, was 363 miles long when it opened the first all-water route to the farm lands of the Midwest in 1825. Its immediate success led Pennsylvania to construct a canal from Philadelphia to Pittsburgh at great expense. For a part of this distance the builders laid a road of rails so that the canal boats could be carried bodily over the crest of the Allegheny Mountains. Other states during those years also followed the lead of New York and began constructing many miles of east-west canals (*see* Canals).

This rerouting of trade had a deep effect on the country. The population of New York City more than doubled in the space of 20 years, as the colorful canal boats entered and left the city carrying passengers and freight. Canals speeded the settlement of the West and made the whole nation more prosperous. But the business depression ("panic") of 1837 put an end to almost all new construction work on canals.

COMFORT ON AN EARLY SLEEPER



Passengers on early railroad trains had little chance to sleep. This "ladies' sleeping car" of 1848 with its flat, hard bunks was a great improvement.

Railroads Revolutionize Travel

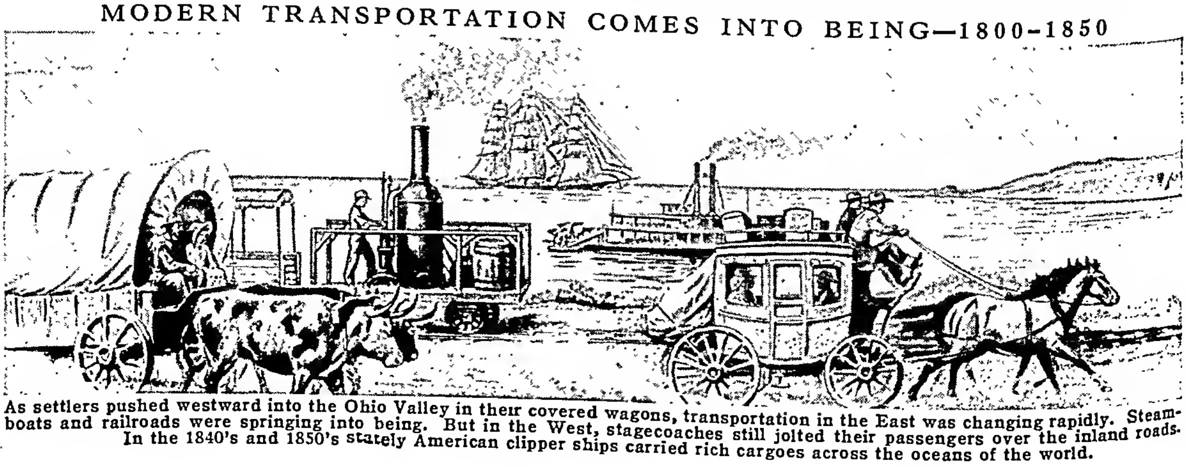
MEANWHILE experiments were being conducted with a new form of transportation of such importance that large-scale canal building was never resumed. The railroad and the steam-driven locomotive were the results of many men's work (*see* Locomotive; Railroads; Steam Engine). Animals had been pulling wheeled vehicles over wooden and iron tracks for many years in Europe and America. Inventors such as Richard Trevithick and George Stephenson in England and Oliver Evans and John Stevens in America tried to drive these vehicles by steam engine. Although Stephenson had made a practical engine in 1829, trains on the first American railroad were still pulled by sails and horses. This was the Baltimore and Ohio Railroad, first opened for traffic on a short line in 1830. In that same year, Peter Cooper's engine, the "Tom Thumb," lost a famous race to a horse on the Baltimore and Ohio Railroad.

The first locomotive made in America for regular use was the "Best Friend of Charleston." It reached a speed of 30 miles an hour on the South Carolina Railroad. This was a remarkable speed for that time. Early railroad cars were stagecoach bodies on flanged wheels. These rolled on wooden beams covered by a strap of iron. Solid iron rails were an improvement of the 1840's. Tracks of varying widths caused inconveniences until a standard gauge was adopted later in the century (*see* Railroads). Ignorance and prejudice brought some opposition to these new machines. Doctors warned of brain concussion from traveling at speeds of 20 miles an hour, and farmers were told that the noise would keep their cows from giving milk.

Swift Growth of Railroads

From 1830 until the first decade of the 20th century the nation built railroads with little interruption. Early lines were laid out as feeders to canals and rivers. As longer main lines came into service, the railroads began to take business away from older kinds of transportation. In 1840 there were 1,076 miles of canal in the United States and 2,818 miles of rail. By 1850, 9,021 miles of railroad had been built, and ten years later more than three times that length

MODERN TRANSPORTATION COMES INTO BEING—1800-1850



As settlers pushed westward into the Ohio Valley in their covered wagons, transportation in the East was changing rapidly. Steamboats and railroads were springing into being. But in the West, stagecoaches still jolted their passengers over the inland roads. In the 1840's and 1850's stately American clipper ships carried rich cargoes across the oceans of the world.

of line was in service. By then railroads had almost driven barge canals from use.

Problems of Finance and Rate Making

THE RISING use of steam power by railroads and steamships greatly altered the character of transportation. In all earlier times, the only bulk carriers had been the Mediterranean vessels, sailing ships, and canal barges. Land transportation was provided by small units—wagons, carts, and drays to haul freight, and horses, carriages, and stagecoaches to carry passengers.

For such transportation the principal expense lay in providing the carriers and the men and animals to operate them. Only simple port installations were needed for loading and unloading ships. Between ports, nature provided the "way" and supplied wind for power.

For land transportation good roads were needed, but until the days of the turnpikes, neither governments nor private interests did much to provide satisfactory surfaces or bridges. Wagons and coaches could struggle along on dirt roads—in good weather—and they had always been allowed to do so. Problems of finance were simple. Although the total number of carriers in service might represent a big investment, each unit or small groups of units could be owned and operated by individuals or by small companies.

THE BEGINNING OF THE PULLMAN ERA

The luxurious "palace sleeping car" of 1867 showed a big advance beyond the uncomfortable sleeper pictured on the opposite page.

Rising Need for Large Investments

Steamships, canals, and railroads led to much greater problems of finance. As soon as steamships became practical, they grew rapidly in size, and construction and operating costs went up accordingly. Soon the only practical way to provide steamship service lay in forming corporations and raising huge sums by selling stock. As steamers grew in size, expensive harbor improvements and docking facilities were also needed.

Both canals and railroads made it necessary for builders to put out huge sums of money for "ways." All this money had to be raised and spent upon the work before a barge or train could move. Until this time, only national and state governments could provide money enough for the biggest canal improvements. Since the early railroads were short, cities or private companies could build them; but once longer lines began reaching into thinly settled regions of the West, financial problems became more difficult.

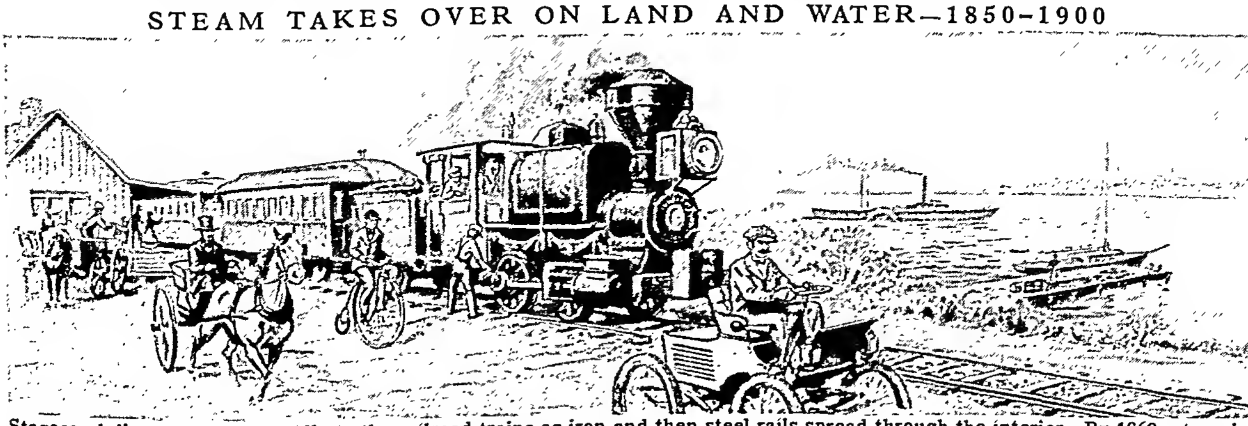
The Western roads could not expect to get traffic enough to earn a profit until the land was more thickly settled; and this would take a number of years. Private investors were not interested in providing the money that was needed unless some additional inducement were offered. The Federal government provided this with grants of public lands to the railroads. They could later sell these lands to the settlers for profit.

Benefits of Mass Transportation

On the other hand, once steamships, canals, and railroads were ready to operate, new opportunities for lower costs were opened up. With older methods, greater and greater numbers of ships and wagons could be used as transportation needs increased. But such growth only provided *more* transportation; it did little to provide *cheaper* transportation.

Steam power changed all this. Steamships soon became big enough to carry more passengers and more cargo than sailing vessels could and to spend less

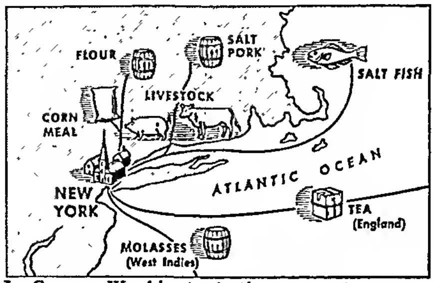
STEAM TAKES OVER ON LAND AND WATER—1850-1900



Stagecoach lines gave way rapidly to the railroad trains as iron and then steel rails spread through the interior. By 1869 a traveler could cross the country from the Atlantic to the Pacific by rail. On the high seas, sailing vessels yielded to steamships. Horses held their own in private transportation. The few gasoline automobiles made before the end of the century were curiosities.

time on a voyage. In addition, the expense of a steamship crew was generally less. On both canals and railroads, hauling costs were low once the way was provided. This also made greater savings possible.

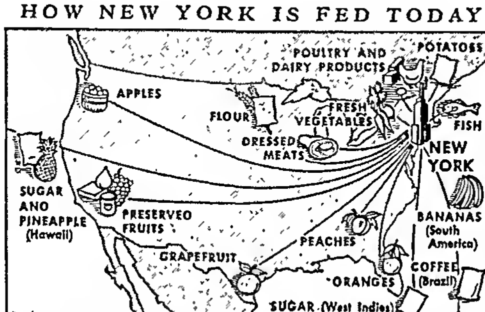
HOW NEW YORK WAS FED IN 1789



In George Washington's time, poor transportation and lack of refrigeration kept fresh food from being carried long distances.

Since the cost of building a railroad was very large and the cost of operating it fairly small, the railroads created special policies of rate making. A railroad always had to consider two factors in setting its freight rates. First, it had to get enough to repay the *direct* costs of hauling. Then it had to get enough more to pay for general expenses and to provide a return on the money invested in construction. The original construction costs, of course, remained the same, whether few or many trains were operated. Therefore it was to the railroad's interest to attract as much traffic as possible and to make rates low enough to do so. In that way, increased volume would more than make up for the low rates.

HOW NEW YORK IS FED TODAY



Today a tremendous variety of food pours into New York City. It comes from all over the country and from distant lands. Only a few items are shown here.

The necessity of getting as much traffic as possible led to a new policy in rate making. Railroads soon learned that low-value, bulk commodities such as coal would not move in great volume over long distances if the rate were fixed high enough to repay all costs. Therefore they granted rates below total cost. This policy served to attract traffic, and it also helped build up towns and industries along the railway lines. As settlements and factories were built up, they in turn provided high-value freight on which "higher-than-cost" rates could be charged.

This type of rate making was called "charging what the traffic will bear." Most of the railroads also disregarded cost and distance to a considerable extent in fixing rates that would help industries along their lines to compete in widespread markets.

Need for Public Regulation

The benefits of this rate-making policy were offset by many serious abuses. In efforts to attract business from large shippers, railroads granted rebates and other favors. Such advantages enabled many shippers to build powerful monopolies. One of the greatest of these was the original Standard Oil Company. Often, when a railroad was the only one serving a region or a community, it charged rates which the people considered unfair.

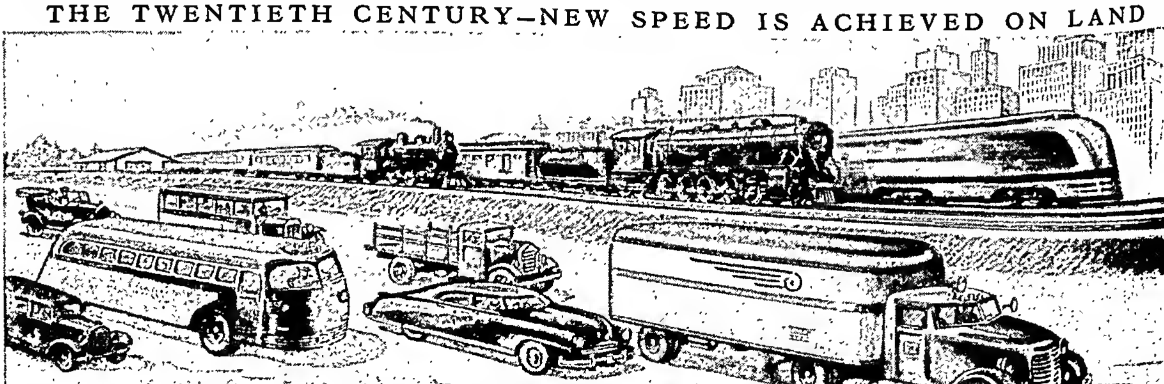
These abuses led to demand for government regulation of rates; and in 1887 Congress passed an act creating a commission to perform this duty for interstate carriers (*see* Interstate Commerce Commission). States and cities also found it necessary to regulate transportation rates and services within their borders. Since then, public regulation has more and more affected privately operated transportation in the United States. Today almost all common carriers are affected by Federal or state regulations in some measure.

Motor Vehicles and Airplanes

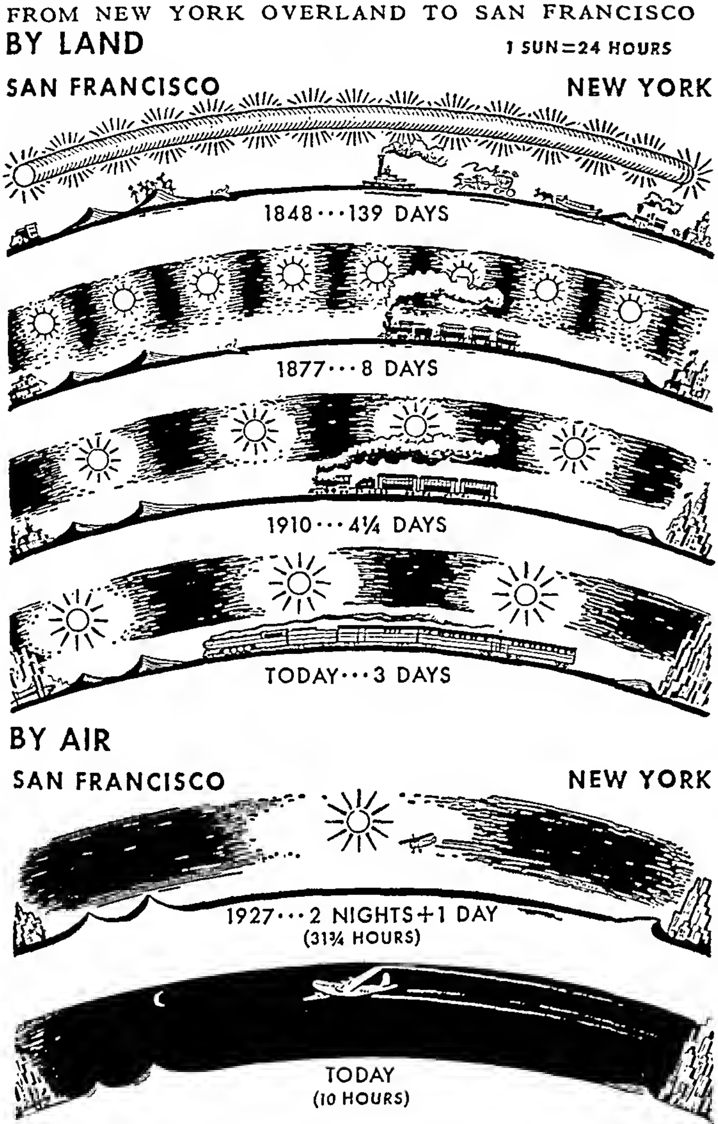
Throughout the 19th century, as railroads took over land transportation, roads were used less and less for long-distance travel and hauling. By 1900, roads between cities and towns were used mainly by farmers and other country people, and maintenance was left almost entirely to local communities.

About the turn of the century, automobiles appeared and began to reverse the trend. The principle

THE TWENTIETH CENTURY—NEW SPEED IS ACHIEVED ON LAND



This picture dramatizes American progress in land transportation between 1900 and the present. In those years the little sputtering "horseless carriages" of the 1890's became the streamlined automobiles and trucks which speed over highways today. Railroad locomotives gained in size and efficiency. More and more, streamlined Diesel-electric locomotives came into use on American railroads.



The time required to cross the continent has shrunk greatly since the days of the gold rush. The figures here are the time required if a traveler used regular or commercial transportation.

of the internal combustion (or gas) engine had been employed to drive vehicles in Europe for many years (*see* Internal Combustion Engine). In 1892 Charles E. Duryea built the first practical automobile in the United States. Gasoline, steam, and electricity all drove early automobiles, but gasoline finally proved most satisfactory. By the time of the first World War automobiles were in general use and this popularity created a widespread demand for good roads.

The "good roads" movement had begun in New Jersey in 1891 under the impact of the bicycle. The high bicycle of the midcentury had developed into the modern type (then called the "safety bike"). More than one million of these were being produced annually by 1900 (*see* Bicycles and Motorcycles). But the automobile made good roads urgent, and their greatest period of expansion came after the first World War (*see* Roads and Streets).

Decline of Water Transport

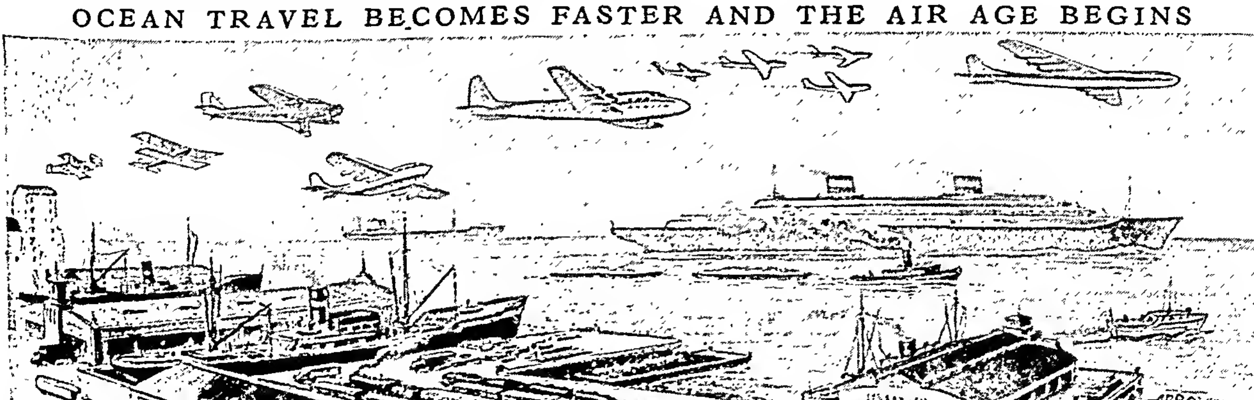
With the development of the railroad and automobile, inland water transportation declined steadily from the peak reached in canal days. By 1914 only bulk freight reached its destination by water. Occasional pleasure cruises put the picturesque river steamer to use, but the most common sight was a string of coal barges towed by a powerful tug.

After 1918 river traffic revived to some extent. A few canals were deepened, and some inland ship channels built. The Mississippi River and its tributaries again became important, and the Great Lakes remained one of the most-used waterways in the world. In 1914 the Panama Canal greatly shortened the water routes between Atlantic and Pacific ports (*see* Panama Canal). The Sault Ste. Marie Canal still carries more traffic than any other internal waterway in the world. (*See also* Sault Ste. Marie; Canals).

The Air Age

Modern aviation dates from 1903, when Orville and Wilbur Wright flew the first successful heavier-than-air machine (*see* Wright Brothers). By 1910 the first airplane flight on schedule time followed overhead the old Indian trail between New

OCEAN TRAVEL BECOMES FASTER AND THE AIR AGE BEGINS



In the 20th century progress was also made in water transportation, and at long last the air was conquered. Swift ocean liners replaced the packet ships of earlier days. In 1903 the Wright brothers launched the air age when they flew the first heavier-than-air craft. In less than 50 years ungainly "flying machines" grew into the almost unbelievably fast jet planes of today.

York City and Philadelphia in one hour and 50 minutes (*see* Airplane).

Progress in this new field was accelerated by the first World War. The first experimental air-mail route was established in 1918, and in 1923 regular coast-to-coast air-mail service was established (*see* Post Office). Transportation of passengers in closed planes began in 1926, and soon scheduled flights crossed the country. The second World War furthered research in the field of aeronautics. Soon no two places on earth will be more than 24 hours flying time apart. (*See also* Aviation.)

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BIBLIOGRAPHY FOR TRANSPORTATION

Books for Younger Readers

Adams, S. H. Pony Express (Random, 1950).
Bechdolt, J. E. Going Up; the Story of Vertical Transportation (Abingdon-Cokesbury, 1948).
Carlisle, N. V. Modern Wonder Book of Trains and Railroading (Winston, 1946).
Carlisle, N. V. and Nelson, E. W. Modern Wonder Book of Ships (Winston, 1947).
Dalgliesh, Alice. America Travels (Macmillan, 1933).
Flack, Marjorie. Boats on the River (Viking, 1946).
Floherty, J. J. Aviation from the Ground Up (Lippincott, 1950).
Frankel, Godfrey. Bike-Ways (Sterling Pub. Co., 1950).
Gilmore, H. H. Model Planes for Beginners (Harper, 1947).
Gossett, Margaret. First Book of Boats (Watts, 1953).
Henry, R. S. Trains (Bobbs, 1954).
Huntington, H. E. Aircraft U. S. A. (Doubleday, 1951).
Lent, H. B. Clear Track Ahead! (Macmillan, 1932).
Lent, H. B. Eight Hours to Solo (Macmillan, 1947).
Leyson, B. W. Modern Wonders and How They Work (Dutton, 1950).
Leyson, B. W. Wings around the World (Dutton, 1948).
Maginley, C. J. Make It and Ride It (Harcourt, 1949).
Mitchell, Helen and Wilson, W. N. Ships That Made U. S. History (McGraw, 1950).
Nathan, A. G. Building of the First Transcontinental Railroad (Random, 1950).
Olds, Elizabeth. Riding the Rails (Houghton, 1948).
Otto, M. G. H. and Stuart. Boat and Ship Book (Sloane, 1951).
Otto, M. G. H. and Stuart. Truck Book (Sloane, 1949).
Reck, F. M. Romance of American Transportation (Crowell, 1938).
Ross, F. X. Young People's Book of Jet Propulsion (Lothrop, 1950).
Shippen, K. B. Bridle for Pegasus (Viking, 1951).
Sutton, Felix. Big Treasure Book of Wheels (Grosset, 1953).
Tatham, Campbell. First Book of Trains (Watts, 1948).
Von Metre, T. W. Trains, Tracks, and Travel (Simmons-Boardman, 1950).
Zaffo, G. J. Big Book of Real Boats and Ships (Grosset, 1951).
Zaffo, G. J. Big Book of Real Trains (Grosset, 1949).

Books for Older Students and Teachers

Armitage, Merle. Railroads of America (Little, 1952).
Beebe, L. M. and Clegg, C. M. U. S. West; the Saga of Wells Fargo (Dutton, 1949).
Buehr, Walter. Ships and Life Afloat from Galley to Turbine (Scribner, 1953).
Buehr, Walter. Story of Locks (Scribner, 1953).
Chapel, C. E. Jet Aircraft Simplified (Aero Pubs., 1954).
Chapelle, H. I. American Small Sailing Craft (Norton, 1951).
Farrington, S. K. Railroads of Today (Coward-McCann, 1949).
Floherty, J. J. Men against Distance (Lippincott, 1954).
Grace, Dick. Visibility Unlimited (Longmans, 1950).
Hart, Virginia. Story of American Roads (Sloane, 1950).
Henry, R. S. This Fascinating Railroad Business (Bobbs, 1946).
Holbrook, S. H. Story of American Railroads (Crown, 1947).
Hubbard, F. H. Railroad Avenue; Great Stories and Legends of American Railroading (McGraw, 1945).
Langewiesche-Brandt, W. E. Stick and Rudder (McGraw, 1944).
Lipsner, B. B. Airmail: Jennies to Jets (Wilcox & Follett, 1951).
Lucas, W A., ed. Popular Picture and Plan Book of Railroad Cars and Locomotives (Simmons-Boardman, 1951).
Popular Mechanics' Picture History of American Transportation (Simon & Schuster, 1953).
Stern, P. V. D. Pictorial History of the Automobile (Viking, 1953).
Winter, W. J. Model Aircraft Handbook (Crowell, 1953)
Yates, R. F. How to Improve Your Model Railroad (Harper, 1953).
(*See also* bibliography for Automobile.)

TRANSVAAL (*trăns-väl'*). Once independent, the Transvaal is now a province of the Union of South Africa. The rugged region thrusts up between the Limpopo River on the north and the Vaal River on the south—hence its name, "beyond the Vaal." To this land between the rivers came the Boers (Dutch), who had trekked from Britain's Cape of Good Hope Colony after the British had freed their slaves in 1833. (For map, *see* South Africa, Union of.)

The Boers clashed with African tribes, especially the Zulus, and with the British. As a result of the conflicts, the British seized the Transvaal temporarily in 1877. A British-Boer war followed in 1880, and the British were defeated at Majuba Hill in 1881. Self-rule was restored to the Transvaal, but Britain retained control over its foreign relations.

More formidable difficulties resulted when gold was discovered in the Witwatersrand, in 1884, and foreigners (uitlanders) flocked in by thousands. Oppression or denial of political rights to these immigrants, under the administration of President Paul Kruger, led to an unsuccessful raid from British South Africa headed by Dr. Leander Jameson in 1895. Despite long negotiations, the Boer War (1899–1902) followed and the Boers were defeated (*see* Boer War). By the Treaty of Pretoria the Transvaal became a British colony. Self-government was granted in 1907, and in 1910 it became part of the newly formed Union of South

Africa (*see* South Africa). The government is carried on by an administrator and a Provincial Council.

The Transvaal is exceptionally rich in minerals. Besides gold, the chief source of wealth, there are diamond, coal, copper, iron, lead, and silver mines. The country is well adapted to agriculture, and stock-raising is still carried on extensively by the Boers, who comprise about half of the white population. Corn and tobacco are the chief crops. The largest city is Johannesburg, the center of the great Witwatersrand gold fields (population, 880,014). Pretoria (284,182) is the capital of the province. The area of the Transvaal is 110,450 square miles; population (1951 census, preliminary), 4,802,405.

TRAPS AND TRAPPING. Winter is the time of activity for the men who make all or a part of their living by trapping wild fur-bearing animals and preparing the hides for market. The animals are now beginning to grow their thick winter coats. Up to this time their fur is thin and almost worthless. From the coastal marshes of Louisiana and Maryland to the snow-covered plains of the Arctic, from the wooded river valleys of the Middle West to the forested mountains of the Rockies or the Coast Range, the hardy and venturesome trappers are preparing for the season's work.

Early in the fall the Indians and half-breeds of Canada have packed their worldly belongings into canoes, visited the trading post of the Hudson's Bay Company, got an advance of money and goods to carry them through the winter, and paddled off toward the arctic cold. When they get to their trapping grounds—the white men one by one, the Indians usually in family groups—the trappers build a permanent camp and make things as comfortable as possible against the days when blizzards rage and the thermometer sinks to 50 or 75 degrees below zero.

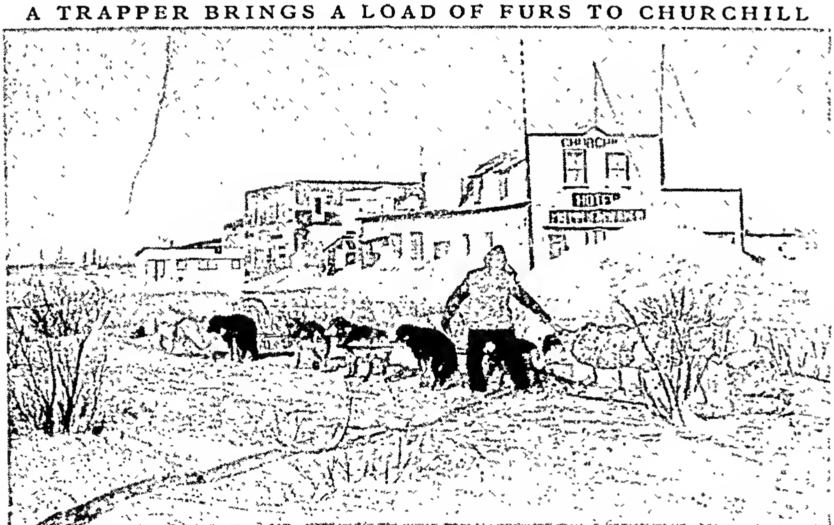
As the first heavy snow falls, the trapper starts out, loaded with steel traps. Scanning the telltale footprints in the snow, he sees that here a fox has passed, there a mink, in another place a marten. At likely places he baits and leaves his traps. He swings around in a wide circle until all his traps have been set, sometimes a hundred or more. Then comes the daily work of visiting as many traps as possible to remove the animals that have been caught, to rebait those that have been robbed by animals too crafty to be taken, and to shift those untouched to likelier places. And when the rounds have been made, there still remains the work of removing and drying the skins. (Pictures of the historic era of trapping will be found with the article Furs and Fur Trade.)

Various Ways of Capturing the Game

There are many ways of trapping or killing animals, but most of our furs come from animals taken in steel spring traps. Shooting is a wasteful method, since the shot or bullets always damage the skin more or less. For taking great animals alive—especially tropical animals such as lions and tigers—pitfalls are used or trap doors in which the animal releases a trigger that drops a gate in place as he crosses the threshold or touches the bait. Birds and sometimes other animals are snared with slipknots. Deadfalls are traps in which a heavy log or other weight drops and crushes the animal when he touches the bait. The Alaskan Indians have a knife trap, in which a heavy blade attached to a lever pierces the victim when he touches the bait. Poison is also used at times.

The steel spring trap is the most effective and also the most cruel device. It has two jaws, with or without teeth; it is closed by powerful springs when the animal steps upon a "pan" between them. The trap is attached by a stout chain to a tree or stake to prevent the animal from carrying it away. Traps for powerful animals are usually attached to a pole, so that the victim can drag it about for a time. This makes it harder for the animal to break the trap by wrenching itself free or pulling up the stake.

A TRAPPER BRINGS A LOAD OF FURS TO CHURCHILL



An Indian trapper is bringing a load of furs into the Hudson's Bay trading post at Churchill, Manitoba, on the bay for which the historic company was named. Trapping is the chief occupation in the winter. Trappers may travel 150 miles by dog sled to the post.

Animals often gnaw off their own legs or paws to free themselves. To prevent this and to prevent small trapped animals from being devoured by larger animals, traps are often attached to the tip of a sapling which is bent down and held in place by a notch on another sapling. When the animal is caught its struggles release the sapling, which flies up and carries the trap and animal out of reach. Its sufferings are further increased as it dangles in the air for hours or even days.

Some states have passed laws requiring the use of humane traps. An organization called "Defenders of Furbearers," in Washington, D.C., is promoting research in the development of painless methods of capture.

It is also trying to educate the public to use ranch-raised skins instead of those from wild animals.

How the Skins Are Removed and Marketed

Skinning the animals is an important and difficult task. This must be carefully done, as the pelt is less valuable if it is damaged. Usually in cold countries the animals are frozen when they are taken from the traps and must be thawed out before they are skinned. The skins of small animals are removed "closed." In doing this the skin on the underside of one hind leg is split up the leg, across the body, and down the other leg. The skin of the tail is worked off the stump without cutting, and the skin of the body is "peeled" much as a glove is taken off. The skins of the larger animals are cut from the throat the full length of the body. Then the pelt is scraped to remove flesh and fat and stretched on a board to dry.

When the ice breaks up and streams begin to run brown, animals start to shed their warm winter coats. Then the trapper's season is over. If he is in the Far North, he takes his catch to a fur company's trading post (*see* Hudson's Bay Company). If he lives closer to civilization, he sends his pelts to a receiving house in a near-by city or town. There skilled men sort the skins for quality and size. The company then mails a check to the trapper for the value of the pelts at current prices. The receiving house sells the skins to a fur merchant or to a broker. If a broker buys the skins, he sells them at one of the fur auctions held in New York City, St. Louis, Montreal, and other centers of the fur trade.

Louisiana leads the states in fur trapping. Its catch of muskrat alone reaches several million skins each year. Other leading fur-trapping states are Wisconsin, Illinois, Michigan, Minnesota, Ohio, and Pennsylvania. The most numerous furs taken in all these states are muskrat, opossum, skunk, raccoon, fox, mink, and squirrel. (*See also* Furs.)

How to Make a Simple Trap

The professional trapper has no monopoly on trapping. Throughout the country, farm boys and girls trap rabbits, weasels, and other animals that damage crops and prey on poultry. A trap for small animals can be made from a medium-sized packing box. First dig a hole in the ground just large enough to admit the box, and deep enough so that only about 12 inches of the box appears above the surface. In each end of the box, level with the ground, cut a hole about 6 inches square.

Into each one of these holes you now fit loosely a narrow box about 18 inches long, in such a way that one third of its length projects inside the big box. From the top of the big box, midway between the two entrances, you hang the bait so it is visible through the smaller boxes. Then you disguise the outside of your trap with branches, or leaves, or snow.

Along comes the rabbit. He smells and sees the bait, and apparently all he has to do is walk into one end of the tunnel, eat his fill, and walk out the other end. But as soon as he puts his foot on the inner end of the entrance box, it tips down and drops him inside. The entrance box then tips back into place and the rabbit cannot find any way out. A door for taking out the captured animals should be cut in the top of the big box.

TREATIES. Treaties are compacts or agreements between two or more states, much like contracts between individuals. They can be made, however, *only by sovereign nations. Thus the states of the* United States cannot make treaties with a foreign power or with one another without the consent of Congress; and the colonies of Great Britain and other countries are likewise restricted in their treaty-making power. The constitution and laws of every government determine in whom the power of negotiating treaties resides. In most European countries it resides alone with the executive or king. The constitution of the United States, while leaving the negotiation exclusively in the hands of the executive, provides for approval by the Senate, "two thirds of the senators present" concurring.

The most important class of treaties is political. Nations are created or destroyed, or their boundaries changed, by the treaties of peace by which countries settle their differences at the end of wars, as in the case of the treaties of Versailles, St. Germain, and Neuilly, which ended the first World War.

Other treaties which have influenced the course of history are those which have formed alliances or leagues, such as the alliance by which France agreed to aid the United States in its war for independence in 1778. Usually alliances are ostensibly defensive, the nations agreeing to aid one another only in case of attack, as in the famous Triple Alliance of Germany, Austria, and Italy; and the Triple Entente of France, Russia, and Great Britain on the other side. Treaties of arbitration have become increasingly important—some for the settlement of particular disputes, as in the famous *Alabama* Claims (*see* 'Alabama' Claims), and others which provide for the peaceful settlement of any "justiciable" dispute which may arise (*see* Arbitration). Other political treaties determine boundaries, cede territory, or guarantee the maintenance of certain conditions, as the neutrality of Belgium and Switzerland or of the Suez and Panama canals. Agreements to mitigate the horrors of war have been incorporated into various treaties.

The increasing interdependence of nations has resulted in the growth of an enormous body of treaties relating to many subjects which are not political—tariff duties, fisheries, the slave trade, the extradition of criminals, postal laws, telegraphs, submarine cables, weights and measures, monetary standards, etc. These agreements are often distinguished from the political treaties by the name "conventions," but this distinction is not always observed. Many of these conventions have resulted in permanently organized international bureaus, like the Universal Postal Union and the Union for the Protection of Industrial Property (patents, trade-marks, etc.).

The need for international coöperation to prevent war has led peace-loving nations to make *multilateral*

treaties—treaties signed by more than two nations. The Covenant of the League of Nations established the first association for the settlement of international problems (*see* League of Nations). After the league failed to prevent the second World War, the United Nations' Conference met in San Francisco in 1945 to draft a stronger instrument, the Charter of the United Nations (*see* United Nations). To avoid the evils of secret treaties, the charter provides that all treaties drawn by member nations shall be registered with the secretariat of the United Nations.

Treaties become valid only when they are ratified. With few exceptions, the negotiation and the ratification of treaties in European states are in the same hands, and ratification follows as a matter of course. In the United States, in several cases treaties negotiated by the president and the state department have been rejected by the Senate.

Refusal to abide by a treaty is a cause of war, unless it has been abrogated by mutual consent or otherwise annulled. If either party refuses to perform a single stipulation of the treaty, the other party is released from his obligations and the entire agreement ceases to be binding; or the injured party may insist upon compliance and demand indemnities for damages caused by the breach. Occasionally (as often in the case of commercial treaties) the period of the treaty's duration is stated in the treaty.

Many important treaties and conventions are framed by international bodies known as "congresses" or "conferences," such as the Congress of Vienna (1815) and the Congress of Berlin (1878). The determinations of such bodies are usually embodied in treaties, but at times are expressed in statements known as "declarations," such as the Declaration of Paris (1856) abolishing privateering and regulating blockade. "Concordat" is the name applied to an agreement between the pope and a secular power for the regulation of ecclesiastical affairs. (For a list of Historical Treaties, *see* Treaties in Fact-Index.)

The KINDLY OLD GIANTS *of the* PLANT WORLD

TREES. When the pioneers settled on the prairies of western America, they planted the seeds of trees as soon as they planted their gardens and fields. Trees made the simple houses more beautiful. In summer they gave welcome shade, and the breeze rustled pleasantly in the cool, green leaves. In winter the trees broke the force of the wind.

Most people love trees for their beauty. But trees are valuable too in many practical ways. Their lumber provides houses, furniture, tools, and fuel. From wood pulp are made rayon textiles, paper, and many different plastics. Millions of trees are cut for telegraph and telephone poles. Trees produce the most important fruits; nearly all nuts; and cocoa, chocolate, coffee, and maple sugar. They supply camphor, quinine, and other medicines; many spices, including nutmeg, mace, cloves, allspice, and cinnamon; olive oil, almond and coconut oil; cork, dyes, rubber, turpentine, gums, and resins. They also help preserve the land and plant and animal life.

What Is a Tree?

A tree is just a plant which grows to large size. The locust tree is the big cousin of the pea, for both are pod bearers. The apple tree is a relative of the strawberry. Both belong to the great rose family (*see* Plant Life).

A plant is usually called a tree if it has a woody stem from 8 to 20 feet or more high. The stem has no branches for several feet above the ground. At the top it has a crown of branches and leaves. Botanists do not separate shrubs and trees. In general, shrubs are smaller. They branch close to the ground and have many stems.

It is not hard to tell most trees apart. The leaf gives the simplest clue to the kind of tree because no two kinds have exactly the same shape of leaf. Flowers and seeds also differ with every kind of tree. In the winter, the shape of the tree and the way it branches, the form of the twigs and buds, and the texture of the bark will tell its name.

The pictures on the following pages will help in learning some common trees by their leaf, bark, and shape. Separate articles on many trees also have pictures. Helpful books are listed in the bibliographies with the articles Botany and Hobbies.

How to Study Trees

You can start the study of trees by making a collection of pressed leaves. You can also make interesting records of leaves, flowers, and seeds by means of simple prints. In the winter collect twigs and study their buds and leaf scars. They differ with every kind of tree. Don't forget to watch for the flowers in spring. On many trees they appear before the leaves. Some are so small you will have to examine them with a magnifying glass. You will be surprised at their beauty.

Botanists divide trees into two main groups, called *coniferous* and *broad-leaved.* Those in the first group bear cones and usually have needle-shaped leaves. Among them are the pine, hemlock, spruce, redwood, cedar, and cypress. Most of them keep their leaves all winter, so we call them *evergreens.*

Trees of the second group have broad, flat leaves. They shed the leaves in winter, so we call these trees *deciduous* (*dē-sĭd'ū-ŭs*). The word comes from the Latin words *de* and *cadere,* meaning "to fall from." The oak, maple, elm, beech, ash, linden, sycamore, and willow are common deciduous trees.

The Oldest Living Things on Earth

The oldest and largest living things on earth are certain trees. Some of the giant sequoias of California grow to be more than 300 feet high and may be 4,000 years old (*see* Sequoia). But even their huge size and great age are not so wonderful as their eternal youth. Between the bark and the wood is a layer of cells called *cambium.* Cambium is perpetually

youthful tissue. The cells at the tip of every twig grow just like cells in a newly sprouted seedling. The botanist De Candolle believed that trees do not die from old age but only from injury or disease.

How Trees Live

A tree has three main parts. The *roots* anchor it in the ground and absorb water and dissolved minerals. The *trunk* and branches carry sap and hold the leaves in the sunlight. The *leaves* make food.

A tree grows higher and wider by lengthening its twigs and branches at the tips. To do this, the terminal buds add cells at the twig ends. Meanwhile, the branches, twigs, and trunk grow thicker.

Conifers and most deciduous trees add thickness as shown in the diagram. Every year the cambium between the sapwood and the inner bark adds a layer of new cells to the older wood. Each layer forms a ring. By counting the rings one can tell the age of the tree. They are thick in years of good rainfall and thin in poor years. Tree rings give a clue to dates in past centuries (*see* Drought).

Some years, however, there may be as many as five rings. These are false rings caused by interruptions of the water supply in the growing season. Drought, frost, fire, or disease may cause false or partial rings. A dry year may also result in a missing ring. A true annual ring can be identified by its sharp outer edge; a false ring, by its fuzzy border.

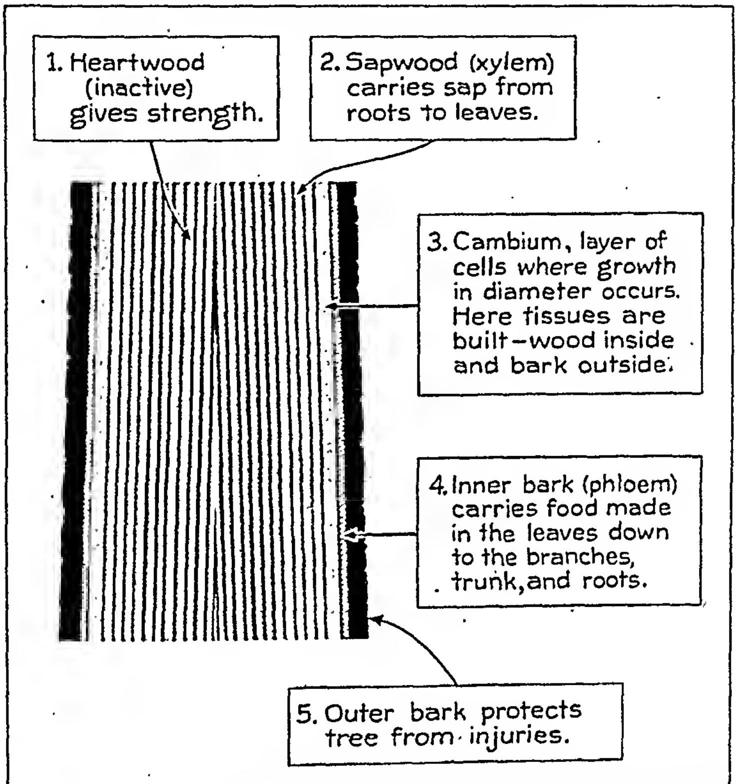
Water and minerals travel up from the roots to the leaves in the new layers of wood inside the cambium. Hence this part of the trunk is called *sapwood* (or *xylem*). Other sap carries food down from the leaves through a layer called *phloem* inside the bark.

Palm trees have no cambium. The woody fibers in the pithy mass of the trunk carry sap up and down. The trunk grows only at the top from a terminal bud.

As the tree grows, the older sapwood stiffens with a hard material (lignin) and loses connection with the leaves. Then it just stores water. At last it becomes solid *heartwood*. Heartwood makes the best lumber. If it decays, a tree surgeon can replace it just as a dentist fills a decayed tooth (*see* Tree Surgery). A tree's roots grow like branches and twigs, at the tips (*see* Root). Many trees send a main *taproot* straight down. It may grow to a great depth seeking water.

While the cambium makes the tree trunk and its branches grow in size, the leaves produce the food which builds the tissues of the tree. Using the energy from sunlight, the green coloring matter in the leaves (chlorophyll) takes carbon dioxide out of the air. It combines the carbon dioxide with water and dissolved minerals from the roots to form sugars and starches. (For more details about food making, *see* Leaves; Plant Life). We cannot see the food-making process at work, but we can feel one result of it by going into a woods on a hot summer day. As soon as we enter the green shade, we find the air cool and fresh. The leaves cut off the glare of the sun and reduce heat by breathing out tons of water vapor into the air. This water was soaked up by the roots and carried to the leaves through the sapwood. The excess not used in making food is breathed out into the air through pores in the leaf. Moreover, leaves purify the air by taking out carbon dioxide and giving back oxygen.

CROSS SECTION OF A TREE TRUNK



Shown here are the chief parts of a tree trunk. The sap (water and minerals) moves up from the roots through the sapwood. The food manufactured by the leaves with the aid of sunlight (photosynthesis) travels down through the inner bark, or phloem. Around the sapwood is the cambium.

How Trees Help the Land

The roots of trees keep soil from washing or blowing away (*see* Conservation; Forests). Leaf mold adds richness to soil. Thick mats of leaves and roots on the ground soak up rain water and keep it from draining rapidly into streams and rivers. The trees also hold water. On one summer day a medium-sized apple tree soaks up about 800 pounds, or 94 gallons, of water. Leaf pores then give out about 96 per cent of the water to the air. The leaves use only about 4 per cent for food making. Thus forests act as reservoirs of rain water, while deforested regions are subject to floods and erosion (*see* Drought; Floods).

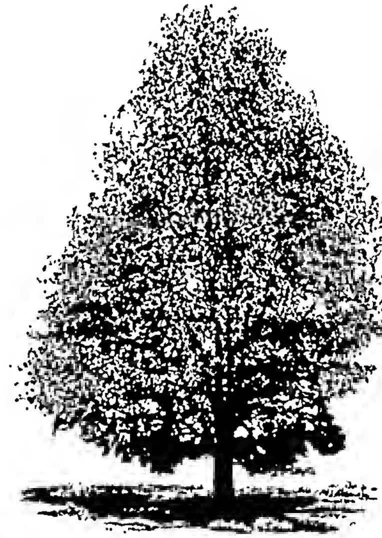
Strange Kinds of Trees

Among the unusual trees are the tropical mangrove and banyan. From their extended branches they send down roots that grow into supporting trunks. Thus each tree becomes a grove (*see* Banyan Tree). The baobab or monkey-bread tree grows immensely broad

Continued on page 184

IMPORTANT HARDWOOD TREES OF NORTH AMERICA—I

1



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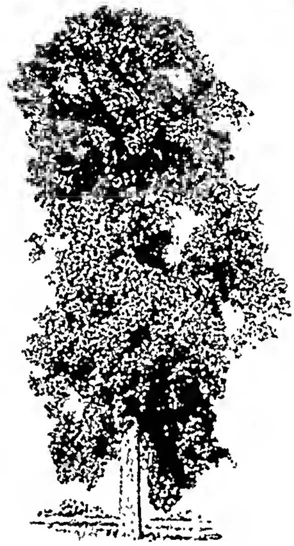

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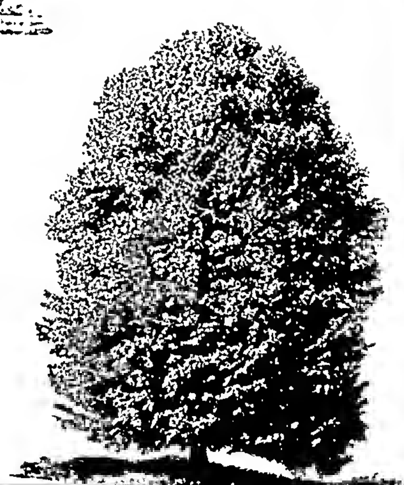

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The trees on this page and the next are ranked as the most important by the hardwood lumber industry of the United States. How many can you recognize? 1. Red Oak (*Quercus rubra*), one of the largest of the oaks. 2. Red Gum or Sweet Gum (*Liquidambar styraciflua*). 3. Sugar Maple or Hard Maple (*Acer saccharum*). 4. Tulip Tree, Whitewood, or Yellow Poplar (*Liriodendron tulipifera*). 5. Yellow Birch or Gray Birch (*Betula lutea*). 6. Tupelo, Sour Gum, or Black Gum (*Nyssa sylvatica*).

7

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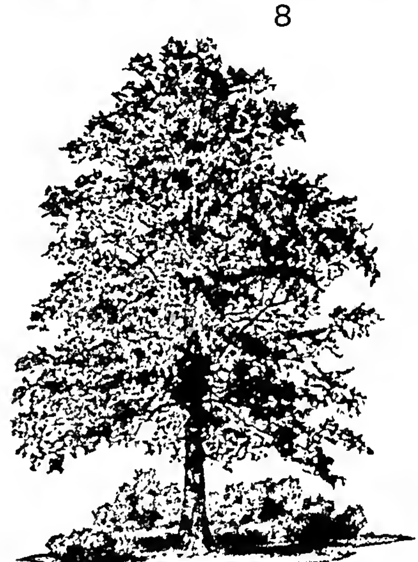

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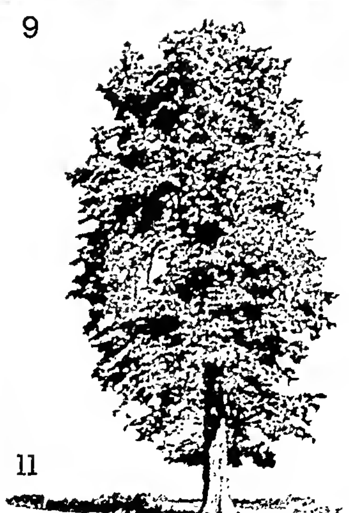

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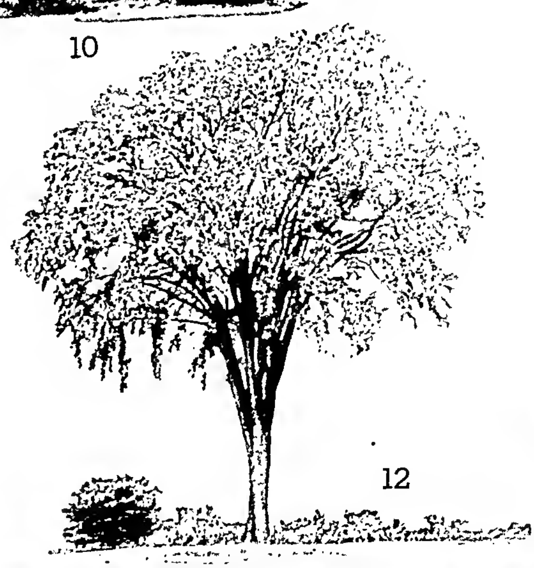

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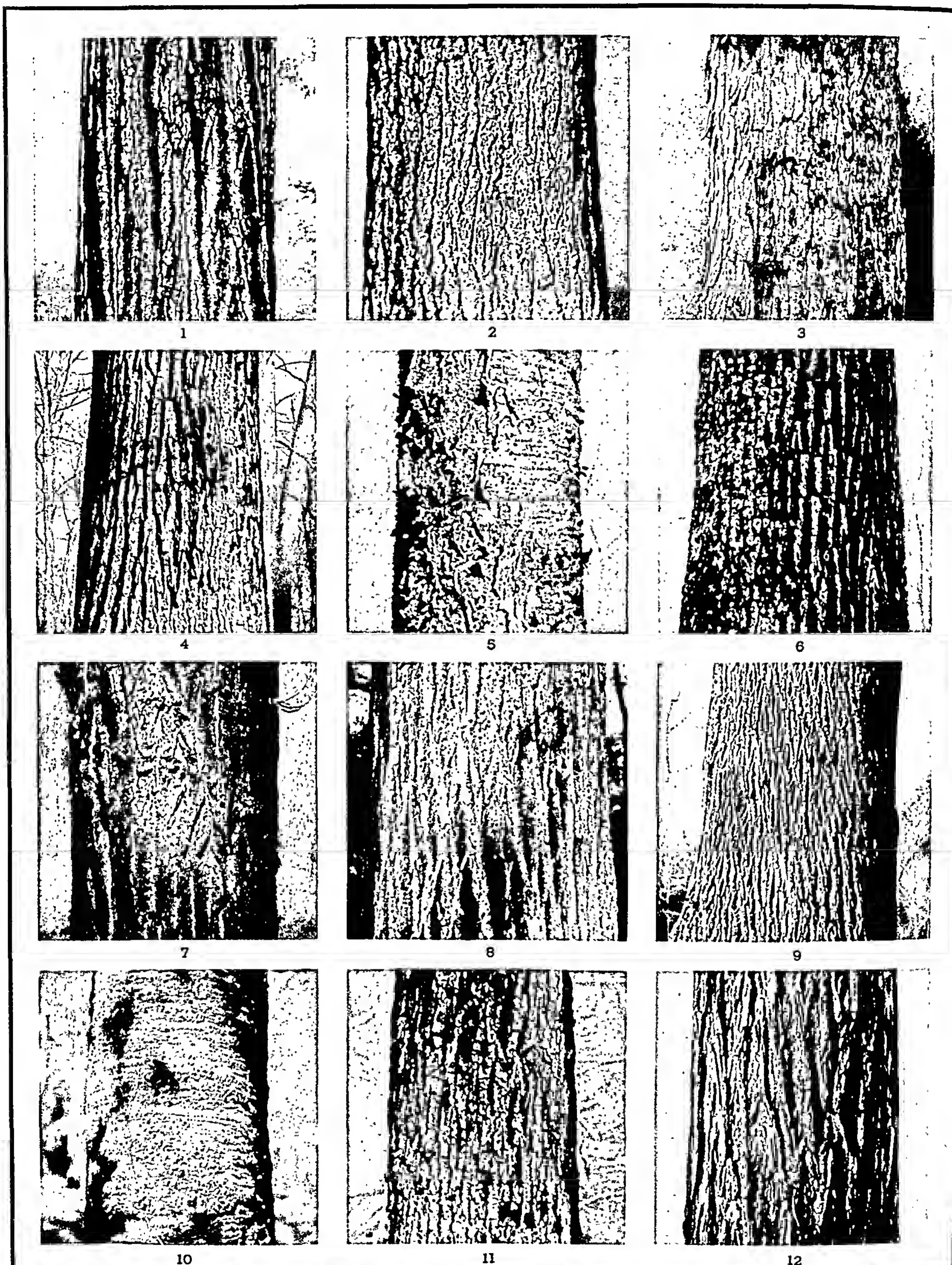
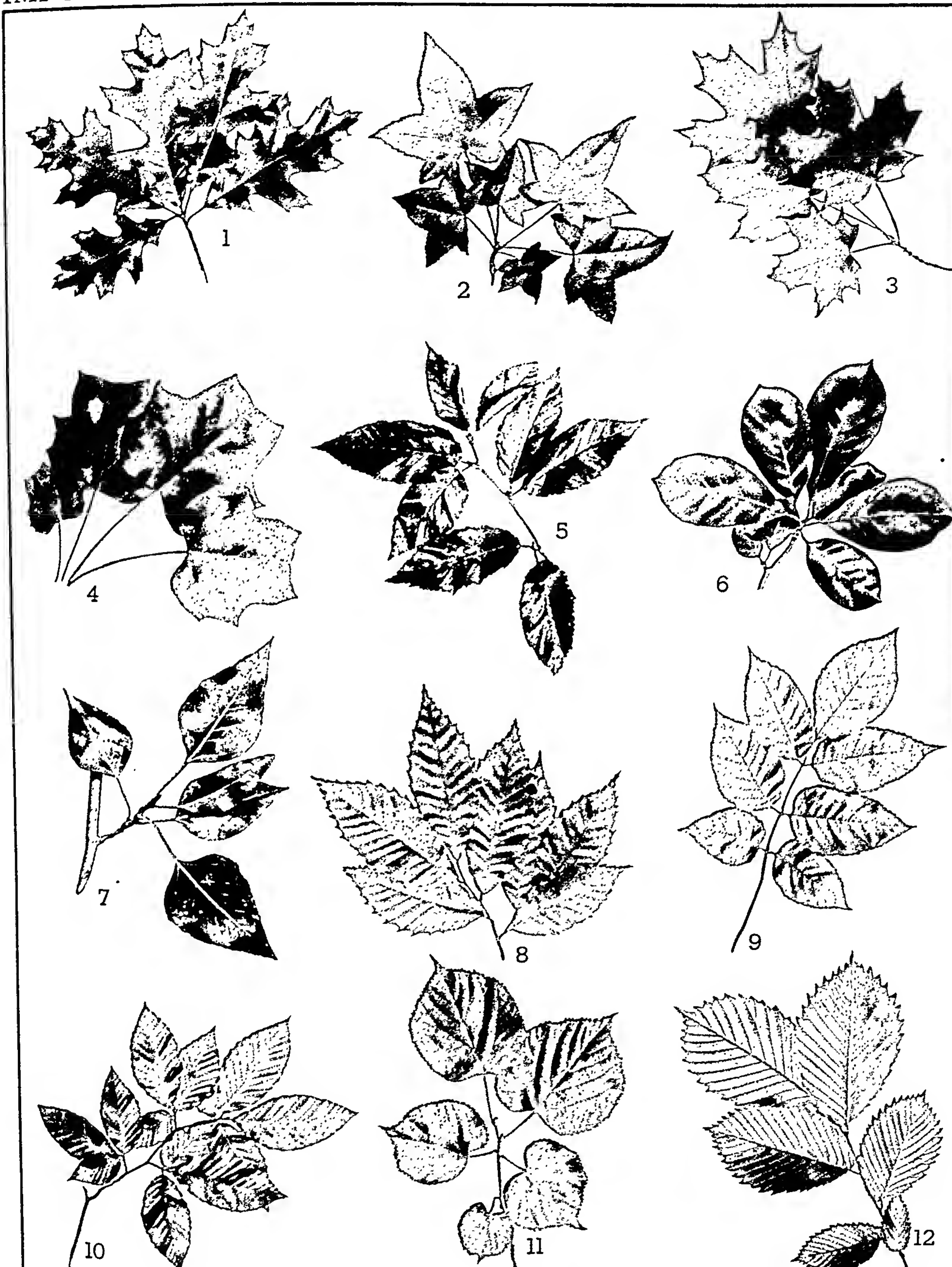
7. Cottonwood or Carolina Poplar (*Populus deltoides*). 8. Chestnut (*Castanea dentata*). 9. White Ash (*Fraxinus americana*). 10. Beech (*Fagus americana*). 11. Basswood or American Linden (*Tilia americana*). 12. American Elm, White Elm, or Water Elm (*Ulmus americana*). These photographs are reproduced through the courtesy of the United States Forest Service and the American Forestry Association. The next two pages show how to distinguish these same trees by close-up views of bark and leaves.



The appearance of the bark is one of the best ways to distinguish hardwood trees in the winter time when the leaves are gone. The pictures here show the barks of the same trees that are illustrated in full view on the two preceding pages. 1. Red Oak. 2. Red Gum or Sweet Gum. 3. Sugar Maple or Hard Maple. 4. Tulip Tree or Yellow Poplar. 5. Yellow Birch. 6. Tupelo or Sour Gum. 7. Cottonwood. 8. Chestnut. 9. White Ash. 10. Beech. 11. Basswood or American Linden. 12. American Elm or White Elm.



Here are illustrated the leaves of the same group of trees shown on the preceding pages. In each case the photograph includes several leaves as they grow on the twig, for the arrangement on the twig is often an important help in identifying them. 1. Red Oak. 2. Red Gum or Sweet Gum. 3. Sugar Maple or Hard Maple. 4. Tnlip Tree or Yellow Poplar. 5. Yellow Birch. 6. Tnpelo or Sour Gum. 7. Cottonwood. 8. Chestnut. 9. White Ash. 10. Beech. 11. Basswood or American Linden. 12. American Elm or White Elm.

without growing proportionately tall. Its trunk may measure 20 to 30 feet in diameter but only 60 to 70 feet high. Its branches, 50 to 60 feet long and each as thick as a good-sized tree, sweep the ground with their foliage. South American forests have several different *cow* trees. They yield a creamy, pleasant-tasting juice, which is said to serve as a substitute for milk. These are related to the rubber trees. The "deadly upas tree" of southeastern Asia was once believed to have a poisonous breath which was fatal to every living creature within ten miles. This has proved to be a fable; but the real upas has a poisonous juice.

Distribution of Trees

Trees cannot grow in deserts, on high mountain tops, or near the poles. Willow and birch, stunted to shrubs, grow farther north than any other woody plants. The Arctic regions, from about latitude 70°, are rimmed with conifers. These trees also comprise the highest forest belt on the mountains of the northern latitudes and they extend into the temperate lowlands. Broad-leaved trees, such as the oak, maple, elm, willow, and ash, flourish in the north temperate zone. In the tropics, leaves become broader, or the fine-leaved foliage becomes denser. Palm, breadfruit, and rubber trees are examples. Some evergreens grow in tropical regions of the Southern Hemisphere, notably the Araucaria group. They nowhere dominate as northern conifers do in the far north. The tough stunted Antarctic beech is the chief forest growth on the chill coasts of the extreme tip of South America.

The conifers and other naked seeded trees (*gymnosperms*) are the most primitive of all seed plants and extend far back in geological time. The giant sequoias and redwoods of the Pacific coast are the only survivors of an ancient and once widely distributed group. The scattered Araucarias of the Southern Hemisphere are the remnants of another formerly widespread clan. The cycads are the most primitive of all trees. Many fossil remains are known. One large deposit is preserved in the Fossil Cycad National Monument (*see* National Parks). Living genera grow in the tropical zones of both hemispheres. They resemble palms or giant ferns. The trunk has no branches. It grows 20 to 60 feet tall and bears at the top a cluster of large palmlike leaves. The cycads live to be a thousand years old. The "living fossil," the ginkgo or maidenhair tree, has an ancestry that goes back to the Coal Age (*see* Ginkgo). The forest trees of that period were similar to the modern fern, cycad, ginkgo, and conifer (*see* Coal).

HOW THE LEAF GROWS

This is the lengthwise section of the base of a horse chestnut leafstalk, showing how the vascular tissue of the stem, carrying moisture and nutriment, branches off into the leafstalk, piercing the corky layer which wraps the stem.

The broad-leaved trees with enclosed seeds (angiosperms) are more highly developed and younger in geological time. Some of them were more widespread in ancient times than they are today. The North American tulip tree and the sassafras were believed to be the sole living representatives of their kind until the discovery of Chinese species of each genus. History has no answer to the question of why sister species should be isolated on opposite sides of the globe.

Some Famous Trees

Because trees live so much longer than human beings, many trees have become historic monuments. According to tradition, Buddha received enlightenment under the sacred bo tree in India. The original tree has vanished, but a bo tree in Ceylon, said to be over 2,000 years old, is venerated by Buddhists as sprung from a slip of the sacred tree. It is a member of the fig genus (*Ficus religiosa*). The Royal Oak sheltered Charles II, king of England, after Cromwell defeated him at Worcester in 1651. In the Charter Oak at Hartford, Conn. (blown down in 1856), patriots hid the Connecticut charter when Andros demanded its surrender in 1687. Under the Washington Elm at Cambridge, Mass. (died of old age in 1923), Washington assumed command of the Continental Army in 1775. In Mexico City is a cypress, the Tree of the Sorrowful Night, under which Cortez rested after his defeat by the Aztecs in 1520.

The redwoods and Douglas firs of the Pacific west coast hold the title to the "world's tallest" trees. Second to them is the eucalyptus of Australia (*see* Eucalyptus). Probably the largest in circumference is the Tree of Tule, estimated to be 175 feet around the trunk and about 150 feet tall. It stands in a village churchyard southwest of the Mexican city of Oaxaca. It is a cypress (*Taxodium mucronatum*), called in English the Montezuma cypress, and in Spanish the ahuehuete (*ä-wā-wā'tā*). Its age has been estimated at 3,000 to 5,000 years. Other trees which

attain remarkably long life include banyans, other cypresses, junipers, yews, olives, elms, and walnuts.

Classification of Trees

The science of trees is called *dendrology* (from the Greek word *dendron* for "tree"). Among the lower or nonseed-bearing orders of plants, the tropical tree fern is the only one that may be called a tree. It grows from spores instead of from seeds (*see* Fern). There are two great divisions of seed-bearing plants. The *gymnosperms* have naked, exposed seeds borne on cones which take the place of flowers. The *angiosperms* enclose their seeds in a seedcase or ovary which ripens into a fruit or pod (*see* Flowers).

The gymnosperms are divided into four orders: *Cycadales* to which the cycads belong; *Ginkgoales*, represented only by the ginkgo or maidenhair tree; *Gnetales*, desert shrubs, and woody climbers and small trees found only in tropical forests; and most important, *Coniferales*, or conifers. The conifers are divided into four families: *Pinaceae* (pine, larch, spruce, fir, hemlock, Douglas fir); *Taxodiaceae* (redwood, sequoia, bald cypress); *Cupressaceae* (cedar and cypress); *Taxaceae* (yew).

The angiosperms include the familiar broad-leaved trees. They are divided into two classes according to the number of their seed leaves (*see* Seeds; Spores). Those with one seed leaf are known as *monocotyledons*. The only true tree in this group is the palm. Other "monocots," often called trees, are the banana; a giant grass, the bamboo; and a member of the lily family, the branched yucca, which grows 40 or more feet tall. All other trees are *dicotyledons*, with two seed leaves.

The dicotyledons, in turn, are divided into two groups—the *Amentiferae*, or catkin-bearing trees, and the *Floriferae*, or flower-bearing trees. The Amentiferae comprise six families: *Salicaceae* (willow, poplar, aspen, cottonwood); *Myricaceae* (sweet gale, bayberry); *Leitneriaceae* (corkwood); *Juglandaceae* (walnut, hickory, pecan); *Betulaceae* (birch, alder, hornbeam, hazel); *Fagaceae* (beech, chestnut, chinquapin, oak).

The Floriferae are further subdivided, according to the type of flowers they bear. The simple flowers of the *apetalous* group lack petals. They include only two families: *Ulmaceae* (elm, hackberry), and *Moraceae* (mulberry, osage orange, fig).

The *sympetalous*, or *gamopetalous*, group has the petals united into a tube. In this group are three families: *Ericaceae* (sourwood), *Ebenaceae* (persimmon), and *Oleaceae* (olive, ash).

The *polypetalous* group is the largest and has the most beautiful many-petaled flowers. It includes the great rose family, *Rosaceae*, which bears the valuable fruits—apples, pears, peaches, quinces, plums, cherries, almonds, mountain ashes, and hawthorns. Other polypetalous families are as follows: *Magnoliaceae* (magnolia, tulip tree), *Lauraceae* (laurel, sassafras), *Saxifragaceae* (saxifrage), *Hamamelidaceae* (witch-hazel, red gum), *Platanaceae* (sycamore), *Leguminosae* (locust), *Zygophyllaceae* (lignumvitae), *Meliaceae* (mahogany), *Aquifoliaceae* (holly), *Aceraceae* (maple), *Hippocastanaceae* (buckeye), *Rhamnaceae* (buckthorn), *Tiliaceae* (linden), *Nyssaceae* (tupelo), and *Cornaceae* (dogwood).

TREE SURGERY. Trees are living things, subject, like all living things, to disease, decay, and death. When a tree is wounded from any cause, fungus spores lodge in the wound, germinate, and send forth creeping threads which attack the cell tissues. Other rot-producing organisms enter. In time a tree is so weakened that it dies unless a tree surgeon saves it.

Until the time of John Davey in 1880, tree surgery was an almost unknown science. Now in any park or city street you may find old trees still flourishing because they were treated by a tree doctor.

If a tree trunk has developed an area of decay, the process of artificial repair is in some respects like dental work. First the rotted wood must be excavated and the cavity cleaned, sterilized with creosote, and waterproofed with tar or asphalt. Shaping the cavity requires expert knowledge. The edges of the bark and sap-wood must also be shellacked to prevent infection and drying out. Shallow cavities are usually left unfilled; weak cavities are mechanically braced; under certain conditions cavities are filled with asphalt, or wood, or cement mixtures installed in sections to allow for the natural swaying of the tree. When the work has been properly done, the bark gradually grows inward in course of time and heals the wound.

Injured branches, resulting from improper pruning or other causes, are treated in a similar way. Limbs should be removed close to the trunk or parent branch so as not to leave a projecting stub. When sawing off a large branch, it should first be undercut to prevent stripping the bark as the limb falls. In all cases it is important to sterilize, shellac, and waterproof the scars. Tree surgery includes other special operations, such as the bracing of weak trees, the guying of limbs to check splitting at the crotch, the removal of girdling roots, and other care that will contribute to the health of the tree.

TRENT, ITALY. In the center of the territory which the Italians used to call *Italia Irredenta* (unredeemed Italy) lies the city of Trent, or Trento. From 1803, with only one break during the Napoleonic era, the inhabitants of this mountain region were under the yoke of Austria until the final treaty of peace after the first World War made the entire Trentino district a part of Italy.

Trent is situated on the Adige River, midway between the Swiss border and the Gulf of Venice. Its strategic importance is due to the fact that it commands the Brenner Pass, between Italy and Germany.

From 1545 to 1563 Trent was the scene of the famous Council of Trent, called to define the Roman Catholic doctrines on points raised by the Reformation and to effect reforms within the church. Population. (1951 census, preliminary), 62,098, including suburbs.

The ANCIENT ART *of* WORKING *in* WOOD

WOOD-WORKING AND WOOD-CARVING. One of the most rewarding hobbies is working in wood. To make a birdhouse, for example, only a few simple tools are needed; and an apple or orange crate provides all the lumber. The beginning wood-carver can trace a design on the end of such a crate; and with a sharp pocketknife and a bit of sandpaper, he can carve out the design in low relief. With practice and a wider range of tools, almost anyone can build shelves, make articles of furniture, or turn out wood-carvings worth putting on display.

'VILLAGE CHIEF'

This wooden statue was carved in ancient Egypt.

Working in wood is one of man's oldest skills. Early men used stone tools to shape tree trunks and limbs into huts, boats, weapons, and ornaments. As men learned to make tools out of metal, their wood-working skill grew. They fashioned such tools as the saw, chisel, ax, and auger; and with them they carved decorations and idols for their homes and temples and made furniture, chariots, spears and bows and arrows, and household articles.

Before the age of machine production, working in wood was divided among a number of skilled trades and crafts. Besides carpentry, wood-workers specialized in wood-carving, furniture making and repairing, wood engraving, making wood patterns for molding metals, cooperage (making barrels and casks), wheelwrighting, making shoe lasts, wood turning on lathes, and coach and carriage building.

Today many articles once made of wood are now made of metal or plastic. And machines now make many wooden articles that used to be fashioned by hand. But skilled carpenters are still needed in many phases of building construction; and patternmakers command high wages in industry. Fine furniture, especially pieces "custom made" for an individual purchaser, requires much hand craftsmanship (*see* Furniture).

The Fine Art of Wood-Carving

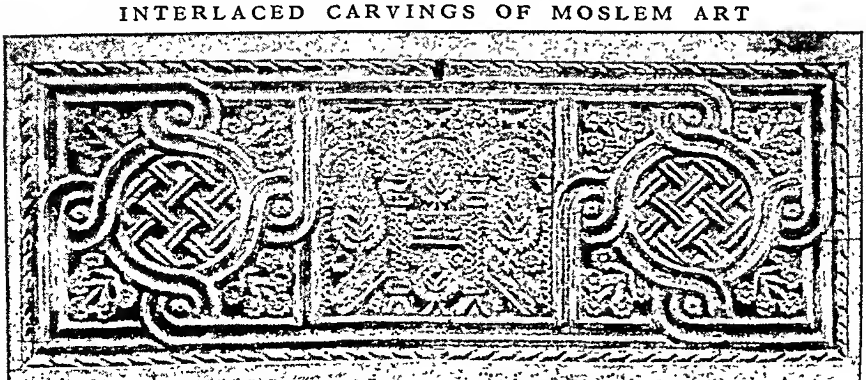
Primitive peoples around the world, living in many ages including the present, have often chosen wood as their material for artistic creation. Indians of Alaska and British Columbia carved elaborate totem poles covered with symbols of their religion and society. Peoples of the Pacific Islands carved intricate designs on their wooden weapons, boats, and household utensils. The most skillful wood-carvers among primitive peoples were the natives of west central Africa. They carved beautiful figures and masks out of hardwood. The best of these carvers did not merely copy nature; they achieved a high artistic effect that has inspired modern artists.

Most of the find wood-carvings of the ancient world are now lost. But one vital work that has been preserved is the figure 'The Village Chief', shown on this page. This was carved in Egypt about 2700 B.C. Fine linen was glued over the wood, and stucco was rubbed in to give a smooth surface. Then the surface was painted. Insets of rock crystal formed the eyes. The work has probably been misnamed; most likely the figure portrays an ancient overseer of workmen.

In the Moslem countries wood-carving reached a high degree of perfection, but in accordance with the religious beliefs human figures were not portrayed. Perhaps the finest of European wood-carvings were made in the 1400's. In churches and in the homes of the wealthy, the furniture, exposed beams, doors, and other wooden objects were covered with richly detailed carvings. Saints and Bible stories were portrayed in wood, surrounded by elaborate scrollwork of geometric or leaf and flower designs.

Nearly every variety of wood, soft and hard, has been used for carving. One essential is an even and close texture, so oak has been universally popular. Many of the exquisite flower, fruit, and leaf carvings of the Englishman Grinling Gibbons (1648–1720) are of lime wood. Other widely used woods have been walnut or chestnut. Beginning wood-carvers get good results with white pine.

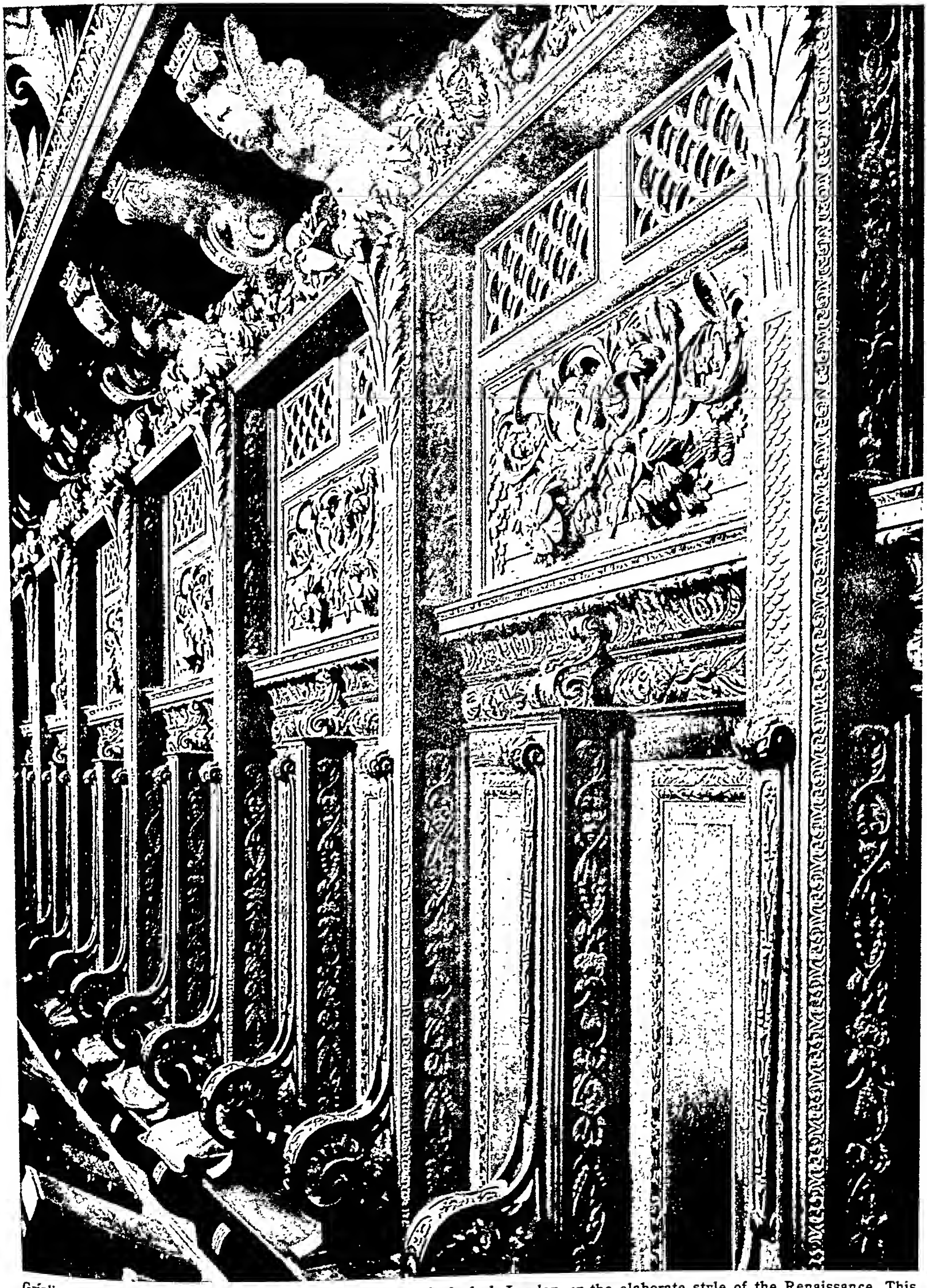
INTERLACED CARVINGS OF MOSLEM ART



This 18th-century Damascus chest front displays a geometric interlaced design. Such wood-carvings from Mohammedan countries were part of the household furniture.

The choice of conspicuous or inconspicuous grain depends upon the artist's purpose. The direction of grain in Mestrovic's 'Christ Driving Out the Money Changers'

THE RICH CARVING BY GRINLING GIBBONS IN ST. PAUL'S



Grinling Gibbons wrought these choir stalls of St. Paul's Cathedral, London, in the elaborate style of the Renaissance. This masterpiece of wood-carving survived the bombings that damaged other parts of the cathedral during the second World War.

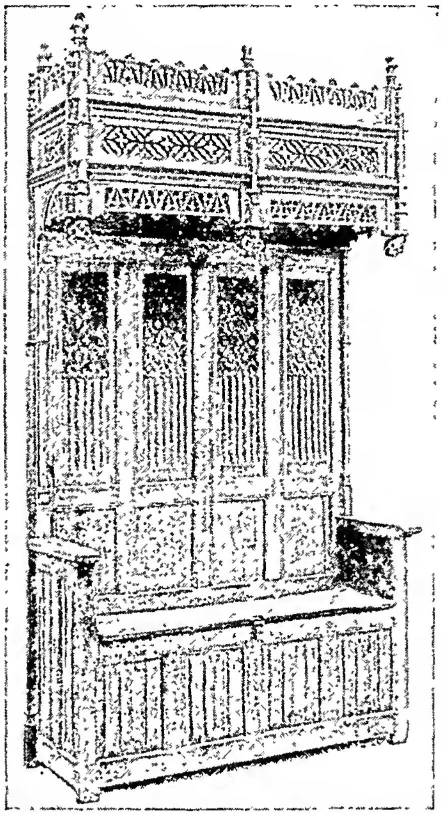
has been utilized to accent the elongated lines of the figures, and emphasize the movement of the design as a whole.

Painted and Gilded Carving

In connection with material, it should be borne in mind that many of the finest works of wood-carving, from the earliest times, have been painted and gilded. In this, as in other important respects, the art took its lead from contemporaneous work in stone and marble. Greek marble and Gothic stone were generally painted and gilded. Many of the world's great artists have avoided leaving raw material in their finished works.

Tastes have varied from age to age and from nation to nation in the appreciation of unfinished material, such as wood or stone. Carved wood, when the dimensions of the work are small and the design intricate, cannot be seen to the best advantage except when painted or gilded. Lacquered, gilded, and painted wood-carving in India and China is of great beauty. However, plain surfaces of natural wood have charm.

THE GREAT DAYS OF WOOD-CARVING



The world's finest wood-carving was done in the 15th century. This Flemish canopied seat shows the beautiful linen-fold paneling.

Few things that the wood-carver has ever done are more indicative of clever artistry and design or more fascinating than the decorated framework of beams in the 16th-century houses still standing in many an old town on the Continent and in England. This framework of uprights and crosspieces, and the sloping sides of gables, are often one mass of leafy forms interspersed with birds, squirrels, and other small animals. Here a grape vine, all leaves and bunches of fruit, twines along the eaves, and there a hop vine climbs to the very top of a lofty gable. At Angers, in France, there is a fine house whose angle support is a huge log carved to represent a tree in leaf and fruit.

ORIENTAL CALM

Buddhistic calm lingers in the lines of this Japanese statue of the 12th or 13th century

The variety of invention in this "domestic" work is as endless as the charm of it is great, giving a feeling of intense vitality such as Austin Dobson must have had in mind when he wrote:

> Where a wistful man might look,
> Finding something through the whole,
> Beating—like a human soul.

The subject matter of the wood-carver has been either decorative, as in the plant forms and in the geometric lacings of the Mohammedans and Scandinavians; or spiritual, as in the fetish art of the African Negroes, and the numberless lovely saints and madonnas, colored and gilded, which have come to us from the greatest of all wood-carving epochs, the 15th century in France, Flanders, Germany, and England. In the best statues of this time, large and small alike, spirituality and personality are expressed with exquisite delicacy and tremendous force. The most intense feelings of joy, grief, or calm are stamped upon the wood, often further enhanced by color. Grace and truth of nature are shown in plant and bird and insect with scientific precision. The design, of which these are but parts, is subjected to the inescapable laws of composition and harmony, which govern truly artistic minds always and everywhere.

The Old Art of Wood-Engraving

Wood-engraving is a trade, or an art, greatly altered by machinery and changed tastes. Years ago, the easiest and quickest way to reproduce pictures in books and magazines was by making a wood-engraving or wood-cut. The engraver first drew the picture on a smooth, hard block of wood, then cut out the wood around the lines of the picture, so as to leave the lines higher than the background. These lines, when inked, would print the picture. Many old woodcuts were very beautiful, but they required much time and skill. The modern newspaper

GAIETY TOLD IN WOOD

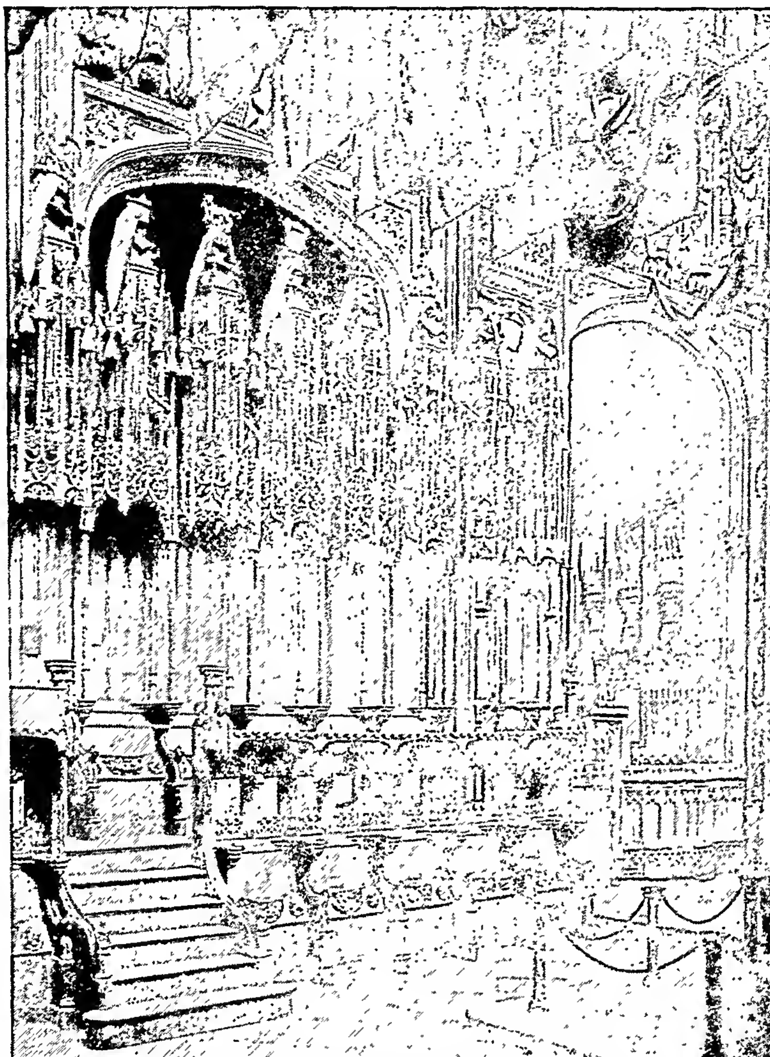
This lively dancer, whose draperies fairly move, was carved about 1480 by Erasmus Grasser for the old town hall in Munich.

and magazine demand a faster method. Pictures are engraved on metal by photographic, mechanical, and chemical processes. Woodcuts are today used only for special artistic effects. (*See* Engraving and Etching.)

The old coopers, or barrelmakers, have also been replaced by the machine, for hand-made barrels are rarely used. The machine today turns out boxes and crates, and releases the skilled hand craftsman for tasks more worthy of his skill. The carriage-maker has also been superseded by the great automobile factories.

Shoe-lasts, once all made by hand, now need have only one model from the hand of a skilled craftsman. This model is then reproduced in large numbers by a copying lathe. This has a spindle, which maintains contact with the model, and shifts the position of the cutting tool as the operation proceeds, so that the cutter produces an exact copy of the model. The copies are used as lasts over which the shoe leather may be shaped. Automatic wood-turning machines have driven out wood-turning by hand, except for making patterns for cast iron and other metals. Skilled mechanics cut the casting models in white pine. Then wet sand is packed around them. When the wooden model is removed, the sand holds its shape and the molten metal is poured into the hollow.

LATE GOTHIC CARVING IN WESTMINSTER ABBEY



In the famous chapel of Henry VII in Westminster Abbey, each stall, assigned to a Knight of the Order of the Bath, displays elaborate carving of the late Gothic flamboyant style. On the seats, and the squires' seats below, the carving is of the later Renaissance style.

Even the carpenter who builds our wooden houses and puts in place the woodwork inside them is finding more and more of his work done for him by the machines of the planing mill, and in his own work he makes increasing use of machines, such as saws driven by electric motors. The cabinetmaker is rapidly becoming a machine worker rather than a hand craftsman. Furniture was once all made by hand, but today electrically driven machines both for producing single pieces of furniture, and in making parts for many pieces of the same kind, are being used for practically all the operations. Machines can do beautifully much of the "donkey work" which hand labor could not do better; but they can never give the artistic touches, the irregular charm, which lends such beauty to skilfully done hand decoration.

It is significant to note that, with the coming of the machine, creative work in furniture design stopped. The great cabinetmakers, Chippendale, Sheraton, Hepplewhite, and others, were men of the hand-work era. (*See* Interior Decoration.) The only new note in cabinet making has been brought about in very recent years in the so-called "modernist" style, which results from a proper understanding of the machine, and gives it only such work as a machine may suitably do. Many simpler pieces of older design may also be made satisfactorily, and of course at much less expense.

Wood-working, whether done by hand or with the machine, involves only a few fundamental operations: planing or shaving, boring, scraping, cutting, or splitting. Planing is done by the plane, the spoke-shave, the draw-knife, and sometimes the chisel; boring by auger bits and drills; scraping by steel and sandpaper; cutting by knives, chisels, and saws; splitting by knives, axes, and the like. Wood-working machines are simply more elaborate forms of these ancient tools. Many of them work in "gangs," shaping or carving several duplicate pieces at the same time. Other operations are shaping, done by steaming the wood, then molding it to shape under pressure; veneering, or covering a cheaper wood with a thin layer of a more expensive kind; and inlaying.

WOOL—*The Best* FIBER *for* WARMTH *and* WEAR

Horse-drawn wagons carry bales of "grease" or unwashed wool from an Australian "run" (the Australian term for a ranch) to market. Only half the weight of each bale is wool. The rest of the bale consists of dirt and grease, which are washed out later.

WOOL. Soft woolen cloth is a favorite material for clothes and coverings throughout the world. People in cold countries make clothes and blankets of it because it keeps them warm. People in warmer lands often wear it to protect themselves from the fierce heat of the sun. Good woolen cloth wears well and keeps its shape. It can absorb moisture and still not feel damp to the skin.

The source of this fine fabric is chiefly the curly hairlike coat of the domestic lamb and sheep. This coat, like the fabric made from it, is known as wool. The hairlike coat, or fleece, of some other animals also is wool but usually has another name. Mohair comes from Angora goats and cashmere from Cashmere goats. Alpaca, llama, and vicuña come from animals of those names. (*See* Goat; Alpaca.)

Woolen material gets its good qualities from the characteristics of its individual fibers. These fibers are finer, softer, and curlier than true hair (*see* Hair). Each fiber is covered with tiny, flat, pointed, overlapping scales. In addition, each fiber is *crimped*, or wavy. The scales give to wool fibers the property of felting (*see* Felt). The crimp and the scaliness together give to woven woolen cloth the quality of *resilience*. This is the ability to return to its original shape, without damage, after being stretched and crushed. The crimp and the scaliness of the fibers also combine to produce many tiny air pockets in woolen cloth. These give to the cloth its insulating quality—ability to protect from both heat and cold—as well as its capacity to absorb moisture.

SHEEP-SHEARING MACHINERY

Clippers, driven by a flexible shaft from a motor, shear a sheep in a few minutes. The thick fleece, matted together, comes off the sheep in one piece like a coat.

Every year the United States raises two to three pounds of wool for each person but uses some four pounds a person. To meet this situation it imports wool. In addition, wool is often used more than once. Manufacturers recover wool fibers from old clothing and manufacturing waste. They

clean these and use them again.

To protect buyers, the United States government passed a Wool Products Labeling Act in 1938. This act requires that products containing wool carry a label showing (1) the amount of wool, (2) the percentage of *new*, *reprocessed*, or *reused* wool, and (3) the percentage of any fiber other than wool that is more than 5 per cent of the content.

According to the act, the term "wool" always means *new* wool—wool that has not previously been used in any way. "Reprocessed wool" has been reclaimed from *unused* woolen materials. "Reused wool" has been salvaged from *used* woolen materials. The Federal Trade Commission set up a fourth term, "virgin wool," to mean wool that has not before been used.

When wool is used a second time it loses some of its precious resilience. It is well to remember, however, that wool varies greatly in quality. Good wool that has been reprocessed is better than virgin wool of poor quality. To judge wool, handle it. Good wool is fine and springy. Poor wool is harsh and inelastic. Good woolen fabrics are soft, clear in color, and even in texture.

BALING THE SHEARED WOOL

After wool is clipped from sheep, it is packed in loose bales. In this warehouse in Montevideo, Uruguayan workers are unloading loose bales into another baler. This will pack the wool into tighter bales for export. A bale of unwashed wool weighs from 100 to 500 pounds.

For centuries sheep have been bred to improve their wool. The Merino, which originated in Spain, has the finest wool today. More popular in the United States is the Rambouillet, which is bigger and hardier, with longer, though coarser, wool. (*See* Sheep.)

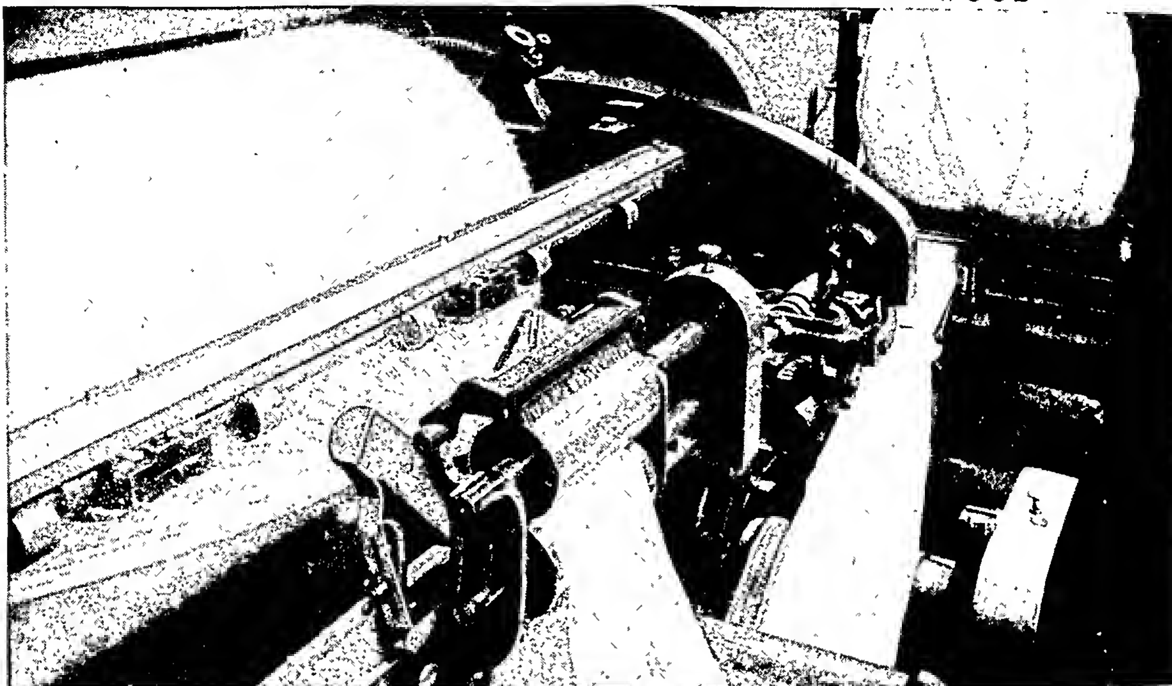
Shearing and Cleaning Wool

Usually wool is shorn from the sheep each spring. In regions which have continuous hot weather, sheep may be clipped twice a year. Hand-power shearing machines are being replaced by electric types. Where there is no electricity, sheep are sheared

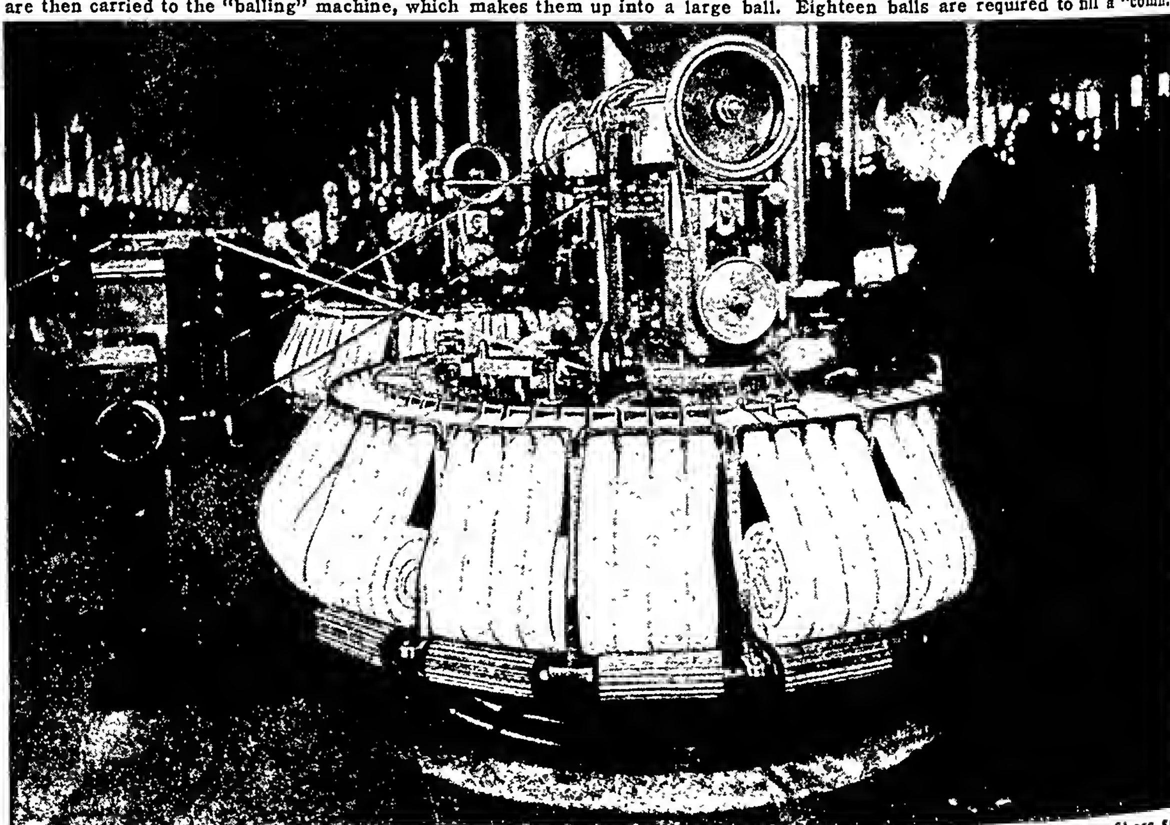
MILL MACHINES REMOVE DIRT AND GREASE FROM WOOL

Bales of unwashed wool go to the mill. Here the fleeces are torn apart and their fibers are carefully sorted. Then the wool is conveyed by automatic rakes through vats of warm soapy water. Rollers wring the water from the wool as it passes from vat to vat.

THE BUSY BARBER THAT COMBS THE WOOL

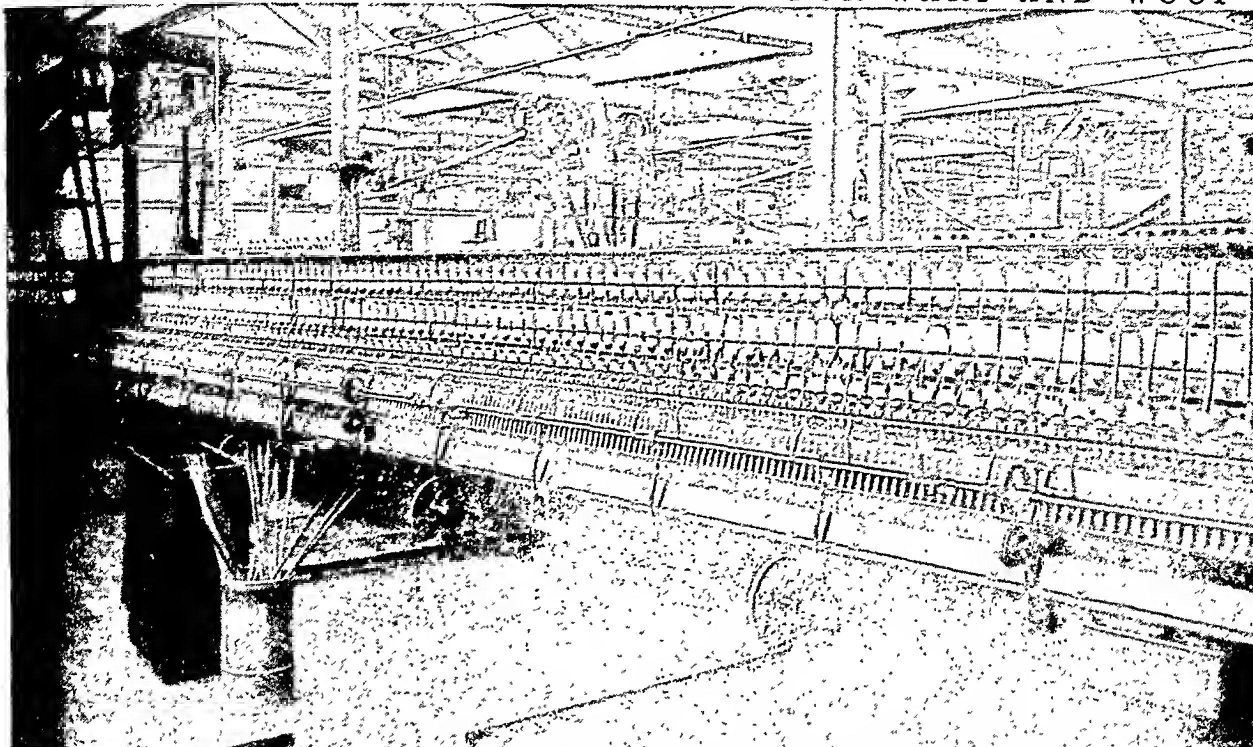


After the wool has heen washed, it is carded. In this process the fihers are straightened by running between rollers with tiny teeth, revolving in opposite directions. These catch and separate the fibers. The wool is wound off into a "sliver" or loose ball, which goes to the "gilling" machine. This macbine straightens the fibers, which come out in the form of soft strands. Four of these strands are then carried to the "balling" machine, which makes them up into a large ball. Eighteen balls are required to fill a "comb."

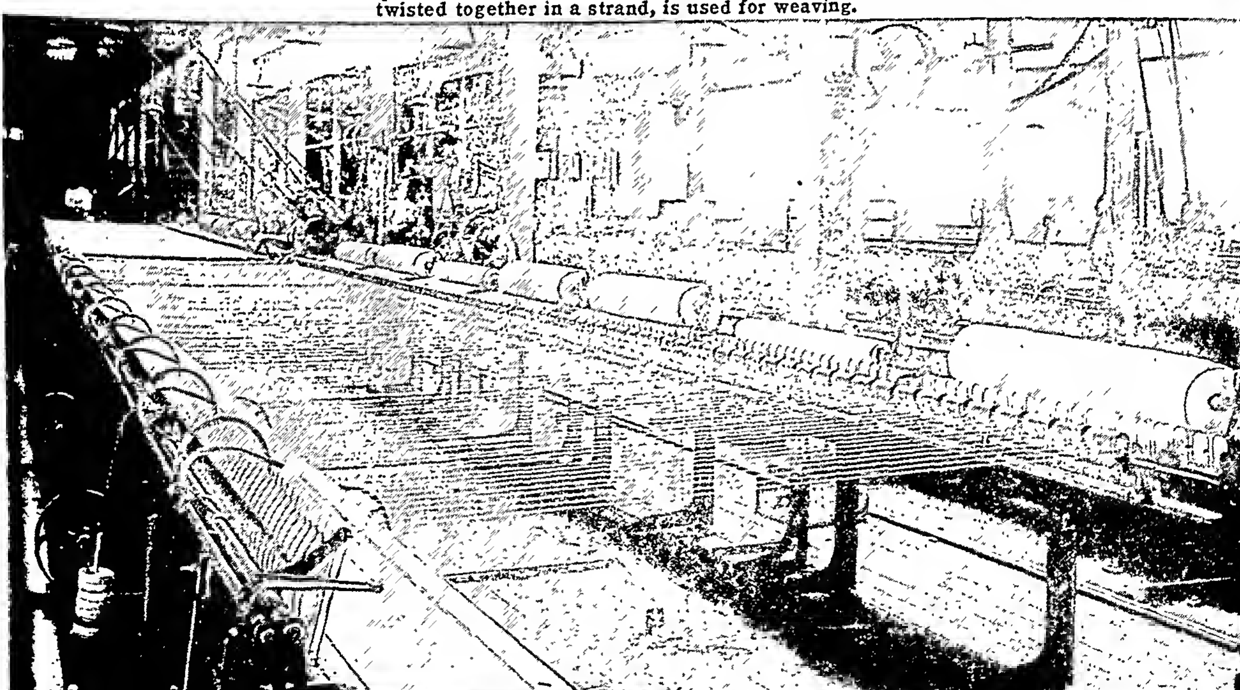


This is a comh filled with the 18 halls. This mechanical harher removes all the short stock or "nibs" and combs the long fibers so straight that they are parallel to each other. When the comhing is finished, the sliver makes two more journeys through the gilling machine and is once more wound into n hall called a "finish top." The fibers are comhed only in making worsteds, not plain woolens. But, whether worsteds or woolens, up to this point no twist has heen given to the wool and it has no appearance of thread.

TWISTING SLIVERS INTO THREADS FOR WARP AND WOOF



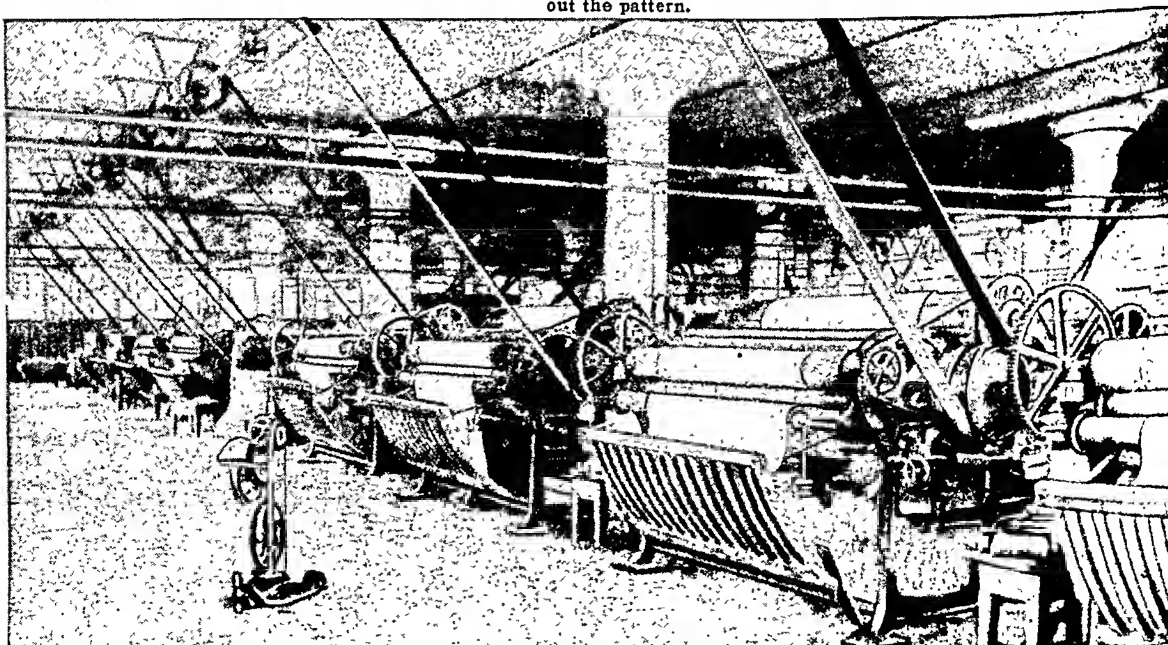
The soft straight wool then takes its first merry-go-round ride. It is run through a machine which twists and draws it into thread, and then it is put through the long spinning machine which you see in the illustration. Here the same process continues until the twisted thread has been drawn to the required size. This twisted thread, sometimes singly, sometimes with three or four threads twisted together in a strand, is used for weaving.



Here is another kind of spinning machine, known as a "mule." The carriage containing the spindles travels back and forth on a track. If the wool was not dyed when it was in the form of a "finish top" it is usually dyed at this stage, as a more uniform color can be obtained in this way than if the finished piece is dyed. The yarn or thread is now carefully inspected, and any imperfections which would show in the finished goods are removed. The thread is now ready to he used either as warp (lengthwise thread) or woof (crosswise thread), depending on its quality and character.

MECHANICAL SPIDERS THAT WEAVE THE WOOLEN WEB

Modern machinery seems to operate consciously, almost as if it were some highly developed animal or even a human being. If you could watch this great loom perform its duties you would he wonder-struck. While the warp threads were transferred to the warp heams, the woof threads were put on shuttle hobhins, which carry the woof thread across the loom. When the warp beam has been properly harnessed and the weaving is started, the loom operates hy what is called a "head motion." This is a mechanical device for raising some ot the threads and lowering others, so that the woof shuttles, passing above some threads and below others, fill out the pattern.



These "napping" or "gigging" machines are used to finish woolens. They pluck or raise the ends of the fibers on the face of the cloth by means of a "teasel," a wire brush shaped somewhat like a pine cone. When the nap has heen raised to the proper length, it is sheared by a machine which works on the principle of a lawn-mower. Worsted cloth is finished by passing through a brushing machine, which lifts the long fibers, and is then sheared just like woolen cloth. Lastly the cloth is pressed or ironed, and it is then ready for measuring, weighing, and packing for the market.

by machines driven by a gasoline engine. With these power-driven machines expert shearers can handle from 150 to 300 sheep a day. The first clip, called "lamb's wool," may be taken when the lamb is from 6 to 8 months old. The fleeces of the older sheep are called "fleece" or "territory" wool. Wool from the pelts of sheep killed in slaughterhouses is called "pulled" wool and is inferior to the shorn wool obtained from live sheep.

After shearing, the fleeces are rolled up in bundles and sent to the mill, where they must be sorted. Not only do the various kinds of sheep furnish widely different qualities of wool, but different qualities are obtained from the same animal. The best wool comes from the sides and shoulders. That cut from the head and chest is irregular and likely to be filled with burrs, and that from the lower parts of the body is usually short, worn, and dirty.

Although the fleece may have been washed on the sheep's back by the farmer or flockmaster it still has to be scoured. Scouring rids the wool thoroughly of the stains of earth and dust which it has picked up, and the greasy matter, called "yolk," secreted by the skin of the animal. The wool is then dried and is ready for "mixing"—the blending of several qualities of wool—to produce cloth of the desired quality. If other materials are to be mixed with the wool—as silk, cotton, or shoddy—they may be added at this stage. Usually, however, they are twisted with the wool yarn after spinning, or combined in the weaving.

The wool is now oiled to restore its natural pliancy, and is ready for "carding," an operation which pulls the fibers apart so that they lie loosely, separated in a uniform film. This is done by revolving cylinders covered with leather strips in which fine long wire teeth are fixed. If the wool is to be used for "worsteds" it must be combed in addition to being carded, to make the fibers lie parallel to one another, so that the threads when spun will be regular in shape and hard and compact. The wool for "woolens" is not combed, but after emerging from the carding machine in light strands called "rovings," goes directly to the spinning room, where the mixed and matted fibers are spun into a soft loose irregular thread.

Spinning the Yarn

In the spinning room the fibers are drawn out and spun into a single yarn. The yarns are then twisted into two, three, or four strands, or used singly, depending upon the coarseness or fineness of the fabric to be made. Soft fragile yarn is often used for "weft" or "filling," but the warp threads must be able to bear much greater strain, and are twisted harder. (*See* Spinning and Weaving.) Formerly nearly all woolen goods were dyed after leaving the loom, but now the practice is becoming more general of dyeing the yarn before spinning.

After the cloth leaves the loom another series of operations begins. First the material passes under the inspection of young women who with needle and thread make good any defects of knotted or broken yarns. Then the cloth is saturated with hot water and soap and rubbed between slow-revolving rollers for many hours to give the amount of shrinkage desired. This process is known as "fulling" or "milling." The soap is then washed out and the cloth is stretched so that it may dry evenly. Next the nap is raised in a "teaseling" machine by means of thousands of little steel hooks which scratch the surface, and then trimmed by a very fine machine which acts on the principle of the lawn mower. After being pressed between hot plates and dry-steamed to impart luster, it is finally ready for market.

Where Wool Is Produced

Australia, Argentina, New Zealand, Russia, United States, Union of South Africa, and Uruguay produce about three fourths of the world's wool. Australia grows about one fourth of the total. The United States averages some 300,000,000 pounds, largely from big flocks in Western states. Texas raises about a quarter of the total. Wyoming, California, and Montana are other leaders. Every state produces some wool.

Wool manufacturing centers in New England, particularly Massachusetts and Rhode Island. (*See also* Fabrics; Spinning and Weaving; Textiles.)

WORCESTER (*wọs'tẽr*), MASS. If ever any city might properly call itself the cradle of invention, it is Worcester, the second largest city in Massachusetts. Within 15 miles of this city's municipal building were born Eli Whitney, the inventor of the cotton gin; Erastus Bigelow, inventor of the carpet-weaving machine; Elias Howe, inventor of the sewing machine; Lucius Knowles, who perfected the modern loom; and the three inventors, Draper Ruggles, Joel Nourse, and J. C. Mason, who perfected the modern plow and devised many other improvements on farming implements.

Conspicuous in Worcester's wide range of manufactures are wire and wire products, abrasives, crankshafts, looms and other fabricating machinery, machine tools, strip steel and steel stampings, and clocks. The city is also one of the leading distributing centers of the state and of the rest of New England.

Worcester was first settled in 1673, but was twice abandoned on account of trouble with the Indians. But in 1722 it was incorporated as a town and in 1848 chartered as a city. In 1775 Isaiah Thomas moved here from Boston with his paper *The Massachusetts Spy* and made Worcester an important publishing center during the War of Independence. The city today is an educational center, housing Clark University, Assumption College, the College of the Holy Cross, the Worcester Polytechnic Institute, a state normal school, Worcester Junior College, and a business college. The library of the American Antiquarian Society, founded in 1812, contains a fine collection on American history. The Worcester Art Museum has paintings and other art works. The Worcester Historical Society has exhibits on local history.

City-manager type of government went into effect in 1950. Population (1950 census), 203,486.

Wordsworth, William (1770–1850). William Wordsworth, the interpreter of nature, the great poet-lover of humanity, and the leader in the poets' revolution back to simple truth and beauty, was born April 7, 1770, at Cockermouth, England, a little village on the River Derwent among the beautiful hills of Cumberland. He came of a family of landowners, and from his earliest days had a deep love for simple country life and for the beautiful region in which he lived. In this outdoor wonderland the serenity of the murmuring Derwent, of the sounding cataract, of forest shadows at noonday, a mountain peak at dawn, or lonely "waters on a starry night" were woven into the very depths of his being.

Wordsworth took his degree at Cambridge University in 1791, without any particular distinction. His life was singularly uneventful except for visits to the Continent. It was on the second of these that he threw himself fervently into the cause of the French revolutionists and was just about to join the Girondins when his disapproving family stopped his supplies, and the lack of money brought him home toward the close of 1792. For three years he lived in an unsettled fashion without prospects or profession until, upon receipt of a legacy from a friend, he took a cottage in Dorsetshire with his sister Dorothy, resolved to devote his life to poetry.

WORDSWORTH'S HOME AT RYDAL MOUNT

In this charming cottage in the famous Lake District, Wordsworth lived from 1813 to 1850. It was only on rare occasions that he left it even temporarily, and he always returned to it with joy. With him lived his wife and his sister Dorothy. Not many miles away was Southey, one of his closest friends and his predecessor as poet laureate. Wordsworth, Southey, and Coleridge were the original "Lake" Poets, whose work marked the beginning of the Romantic movement in English literature.

Wordsworth's life from this time on was one of "plain living and high thinking." In 1797 the poet settled at Alfoxden in Somersetshire, where under the stimulating friendship of Coleridge he began his really important writing. The two poets wandered, talked, and walked and worked together, producing in 1798 their famous collection of 'Lyrical Ballads'. In the second edition of this anthology Wordsworth startled the literary world by declaring that poetry was the "spontaneous overflow of powerful feelings," and that poets should have for their creed simple scenes, everyday words, truth to nature, and imagination. In the book itself were such splendid applications of this creed as Coleridge's 'Ancient Mariner', and Wordsworth's 'Lines above Tintern Abbey', 'Michael', and 'The Revery of Poor Susan'.

In spite of the ridicule which his themes and his frequent lapses into commonplace provoked, Wordsworth kept on writing for the rest of his long life, composing many very dull and a number of very beautiful poems, and doing most of his best work by 1807. He made his home for the last 50 years of his life at Grasmere and Rydal Mount in the Lake District in the North, where, in 1802, he married his cousin, Mary Hutchinson. Gradually he won public favor, and was made poet laureate seven years before his death in 1850.

In his long poem 'The Prelude' this serene poet gives an account of his mental growth and tells how his boyish love of nature's physical beauty changed to an appreciation of the tranquillizing spiritual kinship between Nature and man. "To me the meanest flower that blows can give thoughts that do often lie too deep for tears," he cries. In many of his poems Wordsworth reveals to us the beauty, harmony, and sublimity of nature. Wordsworth is undramatic but his best nature poems, a number of his sonnets, and several of his simple peasant poems in which he lifts the commonplace into genuine poetry, are immortal. As Matthew Arnold puts it: "Wordsworth's poetry is great because of the extraordinary power with which Wordsworth feels the joy offered us in Nature, the joy offered us in the simple affections and duties; and because of the extraordinary power with which he shows us this joy, and renders it so as to make us share it."

Wordsworth's finest poems are 'The Solitary Reaper', 'Michael', 'Lines above Tintern Abbey', 'Daffodils', 'Intimations of Immortality', some of the 'Lucy' poems, 'Westminster Bridge', 'The World Is Too Much with Us', and 'To Milton'. His published works include: 'An Evening Walk', and 'Descriptive Sketches' (1793), 'Lyrical Ballads' (1798), 'Poems' (1807), 'The Excursion' (1814), 'The White Doe of Rylstone' (1815), and 'The Prelude' (1850).

WORKING CONDITIONS *and* WORKING EFFICIENCY

WORK AND FATIGUE. Under what conditions does the individual work most effectively? What are the factors which make for efficiency? What factors work against efficiency? How long should a person work? What is the relationship between work and sleep, between work and fatigue, between work and other conditions such as ventilation, distraction, temperature? These are interesting and practical problems, both to the worker and to the employer.

If we set someone at a job and keep him at it continuously without rest, ultimately he will break down and be unable to go on. If rest intervals or changes of activity are introduced, the person will be able to work for a much longer period of time. Efficiency, then, seems to be in large part a matter of the distribution of work and rest periods. In ordinary life there is regular alternation between work and rest. We work during the day, and sleep at night. We continue to alternate between work and rest, year in and year out.

Suppose now we consider a single period of work. We notice first that the worker is less efficient at the very beginning than he is after working a short time. This phenomenon, called "warming up," is found in many different activities. The baseball pitcher who goes into the box "cold" is less efficient than the pitcher who has warmed up. Some pitchers need a long warming-up period and others need a short period. The speed with which the point of highest efficiency is reached varies from individual to individual.

When We "Let Down"

After warming up, the worker reaches a high level of performance which continues for some time. Then his efficiency begins to fall off, and the longer he works the less he is able to produce. The time at which this drop comes varies with different activities, and at different times in the same person. Some pitchers "blow up" in early innings and some pitch a whole game without loss in effectiveness. Usually the more strenuous the activity, the sooner occurs the falling off. The drop is more marked when a simple and monotonous task is carried on at a high rate of speed, than in a complex and involved task.

But now suppose our worker who has been on the job all morning, knows that he is to stop at twelve o'clock. Usually there will be an increase in efficiency just before the work period is completed. This is commonly known as the "end spurt." When the worker realizes that he is almost through he settles down to his task with new interest and incentive.

If we carry on any physical activity for a long period of time we become tired and stop. Under exceptional conditions, where motivation is unusually strong, as for instance, in an emergency, the ordinary indications of fatigue may be neglected. But usually they are heeded. If high efficiency is to be maintained, rest periods must alternate with work. In certain industrial plants interesting studies of the distribution of rest periods have been made. In one factory where men were hauling pig iron in wheelbarrows, no man obtained the bonus for exceeding the minimum requirements of the job, when left to himself to work as he wished. All were so interested in the bonus that they kept right on working and quickly became fatigued. But when a foreman blew a whistle every 12 minutes, at which each man stopped, sat down, and rested for 3 minutes, it was found that all the men earned the bonus. At the end of the week it was found that the men earned on the average 40 per cent more than when they worked straight along without rest. Here the introduction of a regular rest period during severe physical labor brought a tremendous increase in production.

Is Mental Work Really Fatiguing?

The question whether mental fatigue exists is much debated. There is no doubt that one wishes to turn aside from mental work which has continued for a long time. Investigations have, however, shown that even over long periods there are only slight decreases in mental efficiency. One investigator multiplied four-place numbers by three-place numbers 12 hours a day for four days. While her efficiency dropped gradually from the beginning to the end of each day, she nevertheless was working very efficiently at the end of the four-day period. However, as a person continues to work he becomes more conscious of other factors in his environment and has a stronger desire to stop. Usually, the simpler the occupation and the more monotonous, the more this tendency manifests itself. The more complex the activity, the longer effective action can be maintained. Practically, it is unlikely that an individual will continue mental work to the point at which it becomes harmful, providing he secures proper exercise, food, and sleep. In general, most individuals work under rather than over their capacity.

Another important factor in both mental and physical work is the speed at which the work is done. Although it is usually supposed that the greater the speed, the greater the fatigue, investigations show that this is not quite the case. For each type of activity there seems to be an *optimum* or best speed, above which the person fatigues quickly and below which he also fatigues or becomes inefficient. Often too slow a speed results in errors that disappear when greater speed is maintained. One of the indications of expert performance is the ability to judge the pace at which the activity is best maintained. The rapid worker is usually the most accurate and the best performer. Possibly this is due to the fact that the rapid worker tries out more different speeds of working and thus finds the one which is most effective, while the slow worker never really discovers what he can do. The ability to work effectively under pressure, without becoming so anxious and excited as to lose efficiency, through false motion and duplication of effort, is one of the most valuable characteristics one can possess.

Obviously, however, the quality of work is as important as the quantity or the speed. No boy who reads 'Treasure Island' cares how long or how short a time Stevenson took to write it. There are many people who could write as much or more within the same period of time, but there is only one 'Treasure Island'. In athletic performances we usually find that good form or quality brings about both the speediest and the most efficient type of performance with the least expenditure of energy and the least fatigue.

Stimulants and Efficiency

Drugs such as alcohol, caffeine, tobacco, and the habit-forming drugs produce harmful effects on both the quantity and the quality of work done. Some drugs, such as tobacco and caffeine, have relatively slight effects; with others, such as cocaine and morphine, the effect is very marked. The effect of any drug on efficiency is proportional to the dose; the larger the dose, the greater the reduction in efficiency. It is also true that the effect of a drug is much greater upon a boy or a girl than upon an adult. (*See* Narcotics.)

Poor ventilation has a harmful effect upon the working of the individual, though investigations indicate that the effects are relatively slight if the individual can be motivated to work. In general, poor ventilation makes one drowsy, sensitive, and nervous, with a growing disinclination to work. So too with humidity. As it increases or decreases to a marked degree, there is a growing disinclination to work. If, however, the individual works on, there is relatively little difference in the amount or quality produced. In general, effective conditions for working seem to be around 68° F., 50 per cent relative humidity, and 10 cubic feet of outside air per person per minute.

Effect of Weather and Climate

Long-range studies in human geography indicate that climate has a great effect on the energy of peoples. White people apparently do their best work in a temperate climate with moist, changeable weather. (*See* Climate; Weather.)

As to the time of day at which the individual works most effectively, there seems to be no reliable conclusion. Many people say that they work better in the afternoon and evening than they do in the morning, and other people say the reverse. These seem to be matters of habit based upon the individual's past experience, rather than upon any feature characteristic of the time of day.

Perhaps the most interesting experiments upon efficiency are those dealing with the effects of distraction upon work. By distraction we refer to any outside or interfering stimulus such as a loud noise, a "back-seat" driver, a continuous interfering stimulus. We would all probably admit that the back-seat driver seriously interferes with the operation of an automobile. Investigations on other kinds of distractions, however, indicate that their effects are actually much less than the worker ordinarily supposes—if only he keeps at his work. The work tends to absorb most of his attention.

In fact, in one investigation a series of loud noises actually increased the efficiency of the workers, by causing them to put forth more effort in order to overcome the distraction. This indicates that, while the effect of a distraction may be relatively insignificant at the time, it is better to save wear and tear on the individual by providing conditions as free from distractions as possible. Obviously, if the distraction actually interrupts the work, there is a loss in efficiency. The schoolboy who has to study in a room with the rest of the family usually gets very little done. A quiet place of his own should be provided.

The Cure-All of Sleep

No discussion of work and fatigue is complete without mentioning sleep, that mysterious process which is so commonplace, and yet so important. In sleep, the toxins and chemical products accumulated in the blood as a result of the day's work and fatigue disappear, permitting the person to rise in the morning refreshed and ready for another day. During sleep there is a reduction in the amount of stimulation received by the person. We shut off the light, pull down the curtains, crawl under the covers, and lie quiet—all of which means that many fewer stimuli are affecting our sense organs. Then the amount of activity is greatly reduced. Although many of us think of sleep as a period of almost complete inactivity, investigation shows this is not the case. Recording instruments attached to beds show that both children and adults are fairly active while asleep, moving on the average as often as once in seven or eight minutes. The activity is, however, less in the early part of the night when one first goes to bed and gradually increases toward morning. The deepest sleep usually occurs about two hours after going to sleep.

In general, investigations on sleep indicate that a considerable amount of sleep is necessary and that the amount varies greatly from person to person. The old saying "early to bed, early to rise" is true; not because late sleep is ineffective, but because the average person does not sleep enough additional time in the morning to make up for the sleep lost by going to bed late the night before. (*See* Sleep.)

The Most Powerful Factor of All

None of these factors, however, is so powerful in determining the quality and the quantity of the work we accomplish as motivation—the spur that drives men on to conquer every handicap and leap over every obstruction. The pages of history are full of the lives of men who worked hard and long under the handicaps of poor health, distractions, disturbing influences, poor living conditions, and who yet achieved a larger measure of success than their fellows who suffered from no such handicaps. But even though strong motivation can overcome the effects of loss of sleep, of bad health, of distractions, of poor conditions, there are definite limits to what motivation alone will accomplish. For long-time efficiency and happiness it is best to observe the principles of health and sound working conditions.

The WORLD *and How Man* LEARNS *to* KNOW *It*

WORLD. To early savage peoples, the little region where they lived was the world. They knew it as far as they could roam and no farther. But the little they explored, they knew very well. They discovered where nourishing berries, nuts, and plant roots grew. They learned what animals to fear. They knew the climate and what changes of weather to expect.

Modern man's world extends all around the earth. He makes use of almost every part. He sends his transportation lines to the farthest corners. His food, his job, his life itself may depend upon the products or people of distant lands.

The words "earth" and "world" are often used interchangeably. In this article, "earth" is used to mean the planet—the rocky ball spinning in space which provides man his home. The word "world" is used to mean whatever portion of the earth any particular people may know and use. It means the neighborhood world of primitive man; the Mediterranean world of the ancient Greeks; and the globe-circling world of today.

Modern Need for Knowing the World

A world as large as the earth itself is vast and complex, but modern people need to understand it for their own protection. Businessmen must know the climate, lands and waters, ports, and produce of the world in order to profit from international trade and transportation. Manufacturers must know which regions yield the metals, fuels, lumber, and other materials they use. Statesmen are obliged to study the countries and peoples of the world.

The average citizen likewise needs to know the different peoples and the problems they face. In a half-century mankind has been involved in two world wars because of ideas, ambitions, and pressures that arose in a few countries. Future chances for peace and better living depend upon all people understanding one another and learning to get along together.

The People and Their Environment

To understand a people, it is necessary to know their surroundings, or environment, and the use they make of it. The environment affects their way of life. It may limit the kinds of work at which they can make a livelihood and the types of farming, manufacturing, or commerce they can carry on profitably. It may help form their ideas and character.

The people, in turn, use and alter their surroundings according to their knowledge, abilities, and heritage. They may improve the environment by draining a swamp to add to their farm land. Or they may damage their surroundings—perhaps by destroying the forests or plowing sloping land so the rich top soil will wash away. Man-made features of the landscape, such as houses, factories, roads, dams, school, and churches, are therefore important in revealing the nature of the people.

The Earth—Its Lands and Waters

A good foundation for understanding the modern world is knowledge of the earth—its size, movements in space, features of land and sea, and relation to the sun. The last is important, because it largely determines the climate over the earth. The article Earth explains the larger aspects of the planet. The articles on Astronomy, Climate, and Geology provide other needed information. The article Latitude and Longitude explains the system used by geographers for locating the earth's features.

Water covers nearly three-fourths of the globe. It makes up the five great oceans, the Pacific, the Atlantic, the Indian, the Antarctic, and the Arctic, and their many fringing seas. The land that covers 28 per cent of the earth is divided into seven continents and myriad large and small islands.

The greater portion of the land lies in the northern hemisphere. Here stretches the largest continent, Asia, two other great continents, Europe and North America, and, in addition, the broad, northern parts of Africa and South America. The two continents wholly in the southern hemisphere are the smallest—Australia and Antarctica. And of these, Antarctica is too cold for human habitation. The concentration of land in the northern hemisphere helps to explain why history's great civilizations originated here; why most of the world's people make their homes here; and why the bulk of the world's commerce flows across its seas and lands.

Distribution of Land Forms and Climates

The distribution of the land's surface features influences the climate and the activities of the peoples in different parts of the earth. Broad plains and valleys are usually good for farming. Mountains raise barriers to rain-bearing winds and to man's travel and trade. Good harbors and fall lines on rivers are favorable places for the building of cities. The distribution of mineral deposits and soils also plays an important part in an area's development.

Climate is the most important factor in the physical environment. It affects the plant and animal life, the soil, the relief, and virtually every aspect of the life of the people. A vast plain may be a barren waste or a corn belt capable of feeding millions, depending upon its climate. Articles on Climate, Weather, Rainfall, Winds, and Water explain the causes and effects of climatic variations.

A knowledge of how plant and animal life are distributed helps to explain activities in different regions. The article on Ecology describes the relationships among plants, animals, and men. For example, the world's grasslands are places where rainfall is too light for the growth of forests. Unless man interferes, grazing animals such as the bison of North America range over the plains. When people settle in these areas they commonly pasture domestic animals on them. They use the portions of the grasslands where most rain falls for growing grain.

Geographers have divided the world into natural regions where physical features, climate, soils, plant and animal life, and men's activities are similar

over large areas. These regions are scattered over the earth. Knowledge of how people use one such region aids in developing the use of a similar area wherever it is found. A commonly used division of the earth into regions appears in the table.

Countries and Peoples

Countries are the most familiar subdivisions of the land. *But division into countries is made by* people for political reasons, and the boundaries seldom match those of natural divisions. Large countries may contain many natural or human-use regions. Knowledge of a country calls for a study of its natural regions and their use as well as a study of its people, its history, and its institutions.

The distribution of population over the world is related to the distribution of the natural features. To understand why people have settled closely in one place and sparsely in another, it is necessary to know about the land and water, soils, minerals, climate, and other features of the natural environment.

People Make Final Decision

But the natural surroundings cannot entirely explain the pattern of population. In one place a people with exceptional command of technology will occupy an area too hot, too cold, too dry, or too rugged for normal settlement. In another the people may be thinly scattered over a productive land because they are not able to make the best use of nature's gifts. The spread of population, therefore, is essentially related to the needs and occupations of the people, the physical and mental characteristics, and their attainments in providing government, education, recreation, science, art, and literature.

Contrast, for example, two densely populated areas—the Ganges Valley on the Indian Peninsula and southern New England. The fertile land and the hot, moist monsoon climate along the Ganges permit millions of people to eke out a living at farming by crude methods. New England's hilly land and cool climate could support only a small farming population. But energetic, skilled, educated people have established industries that support several million people. Their commercial firms bring raw materials from all parts of the world and goods to meet the varied needs of a people with a high standard of living. New Englanders have also contributed greatly to their country's government and education.

Compare the use of the same surroundings by people of different stages of culture. Centuries ago the Indians in California's dry valleys lived miserably on nuts, seeds, berries, insects, and fish, without attempting to cultivate crops. Today these valleys are richly productive and well settled. A people with enterprise, great technical attainments, and vast economic resources brought the waters of distant streams to the fields and employed scientific cultivation methods on the land (*see* California).

MAJOR NATURAL REGIONS

A. Tropical Lands
1. Equatorial Type
2. Summer Rain or Savanna Type
3. Tropical Monsoon Type
4. High Plateau Type
5. Hot Desert or Sahara Type

B. Warm Temperate Lands
1. Warm Eastern Margins or China Type
2. Mediterranean Type
3. Interior Lowlands (Warm)
4. Iran Plateau Type
5. High Plateau Type

C. Cool Temperate Lands
1. Eastern Margins of Cool Temperate Lands
2. Interior Lowlands. Cool Forest Type
3. Interior Lowlands. Cool Grassland Type
4. Western Margins of Cool Temperate Lands
5. Mountain Type

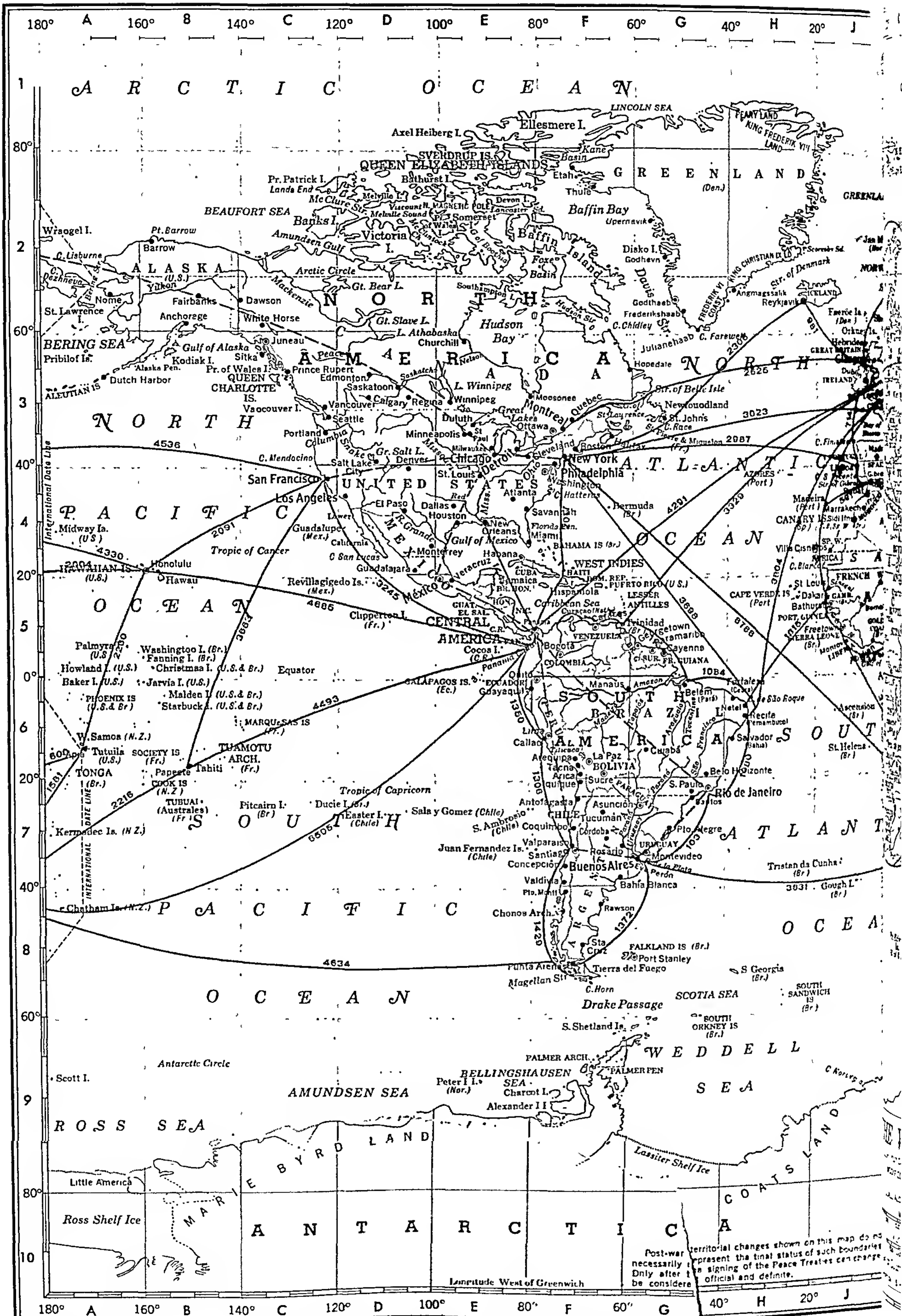
D. Cold Lands
1. Tundra Type
2. Cold Desert Type

Learning About the World in School

Geography is the school subject in which children learn about the world (*see* Geography). Today's geography courses begin by explaining a few regions to the pupils. They start with their own community and identify its natural and man-made features. They list the occupations of the people, and their political, educational, cultural, and recreational institutions. They learn that their community is connected with other parts of the great world.

Next, they take up human-use regions that differ widely from the home scene. In the areas commonly studied human life is simple, and in some instances even primitive. In such regions people's lives are likely to be greatly influenced—even controlled—by nature. As pupils learn about these regions and their people, they come to see the relationship between man's activities and his environment. Regions commonly studied include a hot, wet land, such as the Congo or Amazon basin; a hot, dry land, usually the Sahara and its oases; a cold land, usually the North Polar region; a seacoast region, generally Norway; a high mountainous region, commonly Switzerland; a lowland, usually the Netherlands. A river delta land and a Mediterranean land may be studied. (*See also* People of Many Lands.)

The pupils learn how people meet their needs for food, clothing, shelter, and means of travel from the resources in these typical environments. Then they advance to the study of areas where society is more complex. Here people are making some of the same adjustments to their surroundings found in the simpler regions. But their higher technical and scientific attainments permit them to rise above the tyranny of nature and to exercise greater choice in their occupations and other activities. They do not need to depend upon the resources of their immediate region. They have developed a web of commerce that opens the resources of the whole world to their use. Through studying peoples and places, and the complex interrelationships among them, the pupils progress toward an understanding of the whole world.

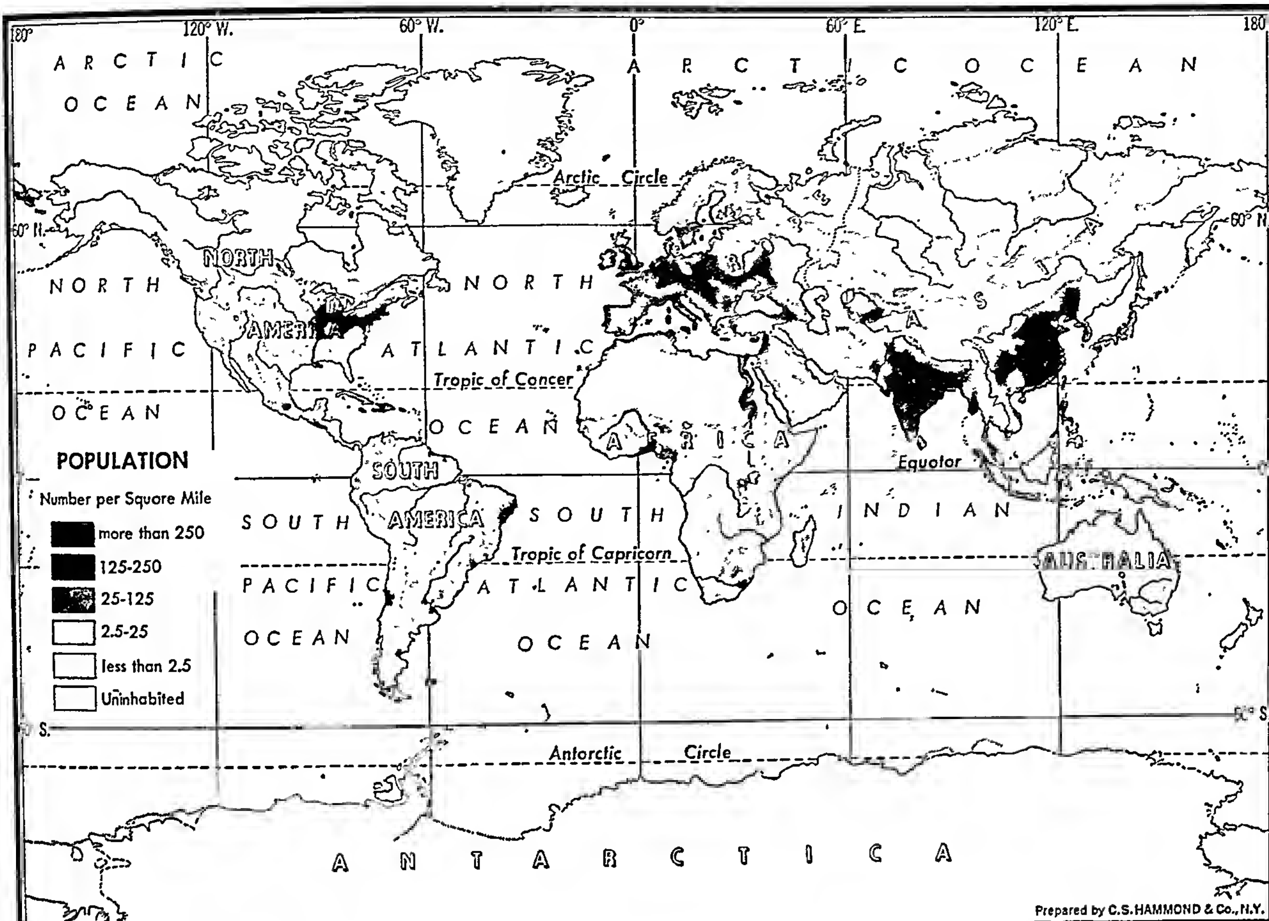


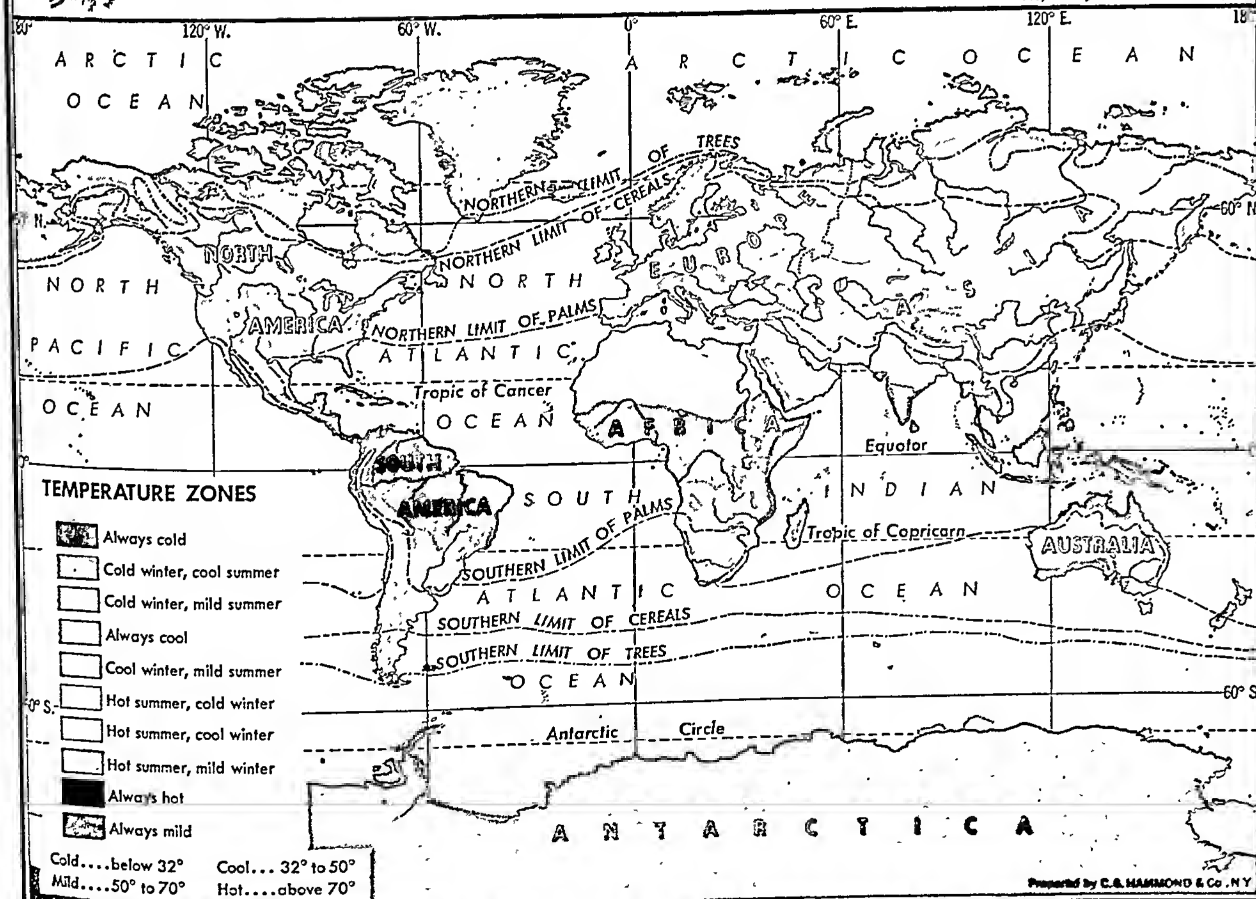
ARCTIC OCEAN
LINCOLN SEA
Ellesmere I.
Axel Heiberg I.
SVERDRUP IS.
QUEEN ELIZABETH ISLANDS
GREENLAND
(Den.)
Baffin Bay
Baffin Island
BEAUFORT SEA
Banks I.
Victoria I.
Wrangel I.
Pt. Barrow
Barrow
ALASKA
(U.S.)
Yukon
Fairbanks
Dawson
Nome
Anchorage
White Horse
Juneau
BERING SEA
Pribilof Is.
Gulf of Alaska
Kodiak I.
Sitka
Dutch Harbor
ALEUTIAN IS
QUEEN CHARLOTTE IS.
Prince Rupert
Edmonton
Saskatoon
Calgary
Regina
Winnipeg
Vancouver
Seattle
Portland
Gt. Bear L.
Gt. Slave L.
L. Athabaska
Churchill
Hudson Bay
NORTH AMERICA
Moosonee
Quebec
Montreal
Ottawa
Newfoundland
St. John's
Duluth
Minneapolis
Chicago
Detroit
Cleveland
Boston
New York
Philadelphia
Washington
Salt Lake City
Denver
San Francisco
Los Angeles
St. Louis
UNITED STATES
Atlanta
Savannah
El Paso
Dallas
Houston
New Orleans
Miami
Gulf of Mexico
Bermuda
Monterrey
Habana
Guadalajara
México
Veracruz
CUBA
HAITI
Jamaica
Hispaniola
WEST INDIES
PUERTO RICO (U.S.)
LESSER ANTILLES
Caribbean Sea
CENTRAL AMERICA
Panama
Trinidad
Georgetown
Cayenne
VENEZUELA
Bogota
COLOMBIA
Quito
ECUADOR
Guayaquil
Manaus
Belém
Fortaleza
Recife
Salvador
SOUTH AMERICA
PERU
Lima
Callao
Arequipa
La Paz
BOLIVIA
Sucre
Cuiabá
Belo Horizonte
S. Paulo
Rio de Janeiro
Santos
Asunción
PARAGUAY
Antofagasta
CHILE
Tucuman
Córdoba
Valparaiso
Santiago
Rosario
Montevideo
URUGUAY
Buenos Aires
Concepción
Valdivia
Bahía Blanca
Rawson
Chonos Arch.
Punta Arenas
Magellan St
Tierra del Fuego
C. Horn
Drake Passage
FALKLAND IS (Br.)
Port Stanley
S Georgia
SCOTIA SEA
SOUTH SANDWICH IS
SOUTH ORKNEY IS
S. Shetland Is.
WEDDELL SEA
PALMER ARCH.
PALMER PEN
BELLINGSHAUSEN SEA
Peter I I. (Nor.)
Charcot I.
Alexander I I
AMUNDSEN SEA
Antarctic Circle
Scott I.
ROSS SEA
Little America
Ross Shelf Ice
MARIE BYRD LAND
Lassiter Shelf Ice
COATS LAND
ANTARCTICA
Longitude West of Greenwich
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
International Date Line
Midway Is.
HAWAIIAN IS.
Honolulu
Hawaii
Tropic of Cancer
Revillagigedo Is.
Clipperton I.
Cocos I.
GALAPAGOS IS.
Palmyra I.
Washington I.
Fanning I.
Christmas I.
Howland I.
Baker I.
Jarvis I.
PHOENIX IS
Malden I.
Starbuck I.
Equator
MARQUESAS IS
W. Samoa
Tutuila
TONGA
SOCIETY IS
Tahiti
Papeete
COOK IS
TUBUAI (Australes)
TUAMOTU ARCH.
Pitcairn I.
Ducie I.
Easter I.
Sala y Gomez (Chile)
S. Ambrosio
Juan Fernandez Is.
Tropic of Capricorn
Kermadec Is.
Chatham Is.
AZORES
Madeira
CANARY IS
CAPE VERDE IS
Dakar
Freetown
Ascension
St. Helena
Tristan da Cunha
Gough I.
ICELAND
Reykjavik
GREAT BRITAIN
IRELAND
Julianehaab
C. Farewell
Hopedale
Str. of Belle Isle
Post-war territorial changes shown on this map do not necessarily represent the final status of such boundaries. Only after the signing of the Peace Treaties can changes be considered official and definite.
180° 160° 140° 120° 100° 80° 60° 40° 20°
A B C D E F G H J


ARCTIC OCEAN
FRANZ JOSEF LAND
(FRIDTJOF NANSEN LAND)
Graham Bell I.
Vilchek I.
SEVERNAYA ZEMLYA
(NORTH LAND)
Komsomolets I.
October Revolution I.
Bolshevik I.
N.E. Land
Edge I.
C. Chelyuskin
TAIMYR PEN.
LAPTEVYKH SEA
NEW SIBERIAN IS.
De Long Is.
NOVAYA ZEMLYA
BARENTS SEA
KARA SEA
Vaigach I.
L. Taimyr
EAST SIBERIAN SEA
Bear I.
Khatanga
Medvezhi Is.
Murmansk
Kolguev I.
Oudinka
Igarka
Kirovsk
G. of Ob
Yenisei
Olenek
Lena
Yana
Arctic Circle
Verkhoyansk
Indigirka
Kolyma
Sredne Kolymsk
FINLAND
White Sea
Salekhard
Berezovo
Lower Tunguska
Vilyui
Vilyuisk
Yakutsk
Anadyr
Arkhangelsk
Onega
L. Ladoga
Dvina
Pechora
Tobolsk
Ob
Olekminsk
Tommot
Aldan
Okhotsk
Magadan
Atka
Stockholm
Leningrad
Kirov
Kotlas
Molotov
UNION OF SOVIET SOCIALIST REPUBLICS
BERING SEA
Tallinn
Riga
Kalinin
Moskva
Volga
Gorki
Sverdlovsk
Chelyabinsk
Omsk
Tomsk
Krasnoyarsk
L. Baikal
SEA OF OKHOTSK
KAMCHATKA PEN.
Komandorskie Is.
Kaunas
Warszawa
Minsk
Voronezh
Saratov
Ufa
Magnitogorsk
Novosibirsk
Irkutsk
Chita
Shilka
Amur
Nikolaevsk
Petropavlovsk
Attu I.
POLAND
Kiev
Kharkov
Kulbyshev
Akmolinsk
Semipalatinsk
Ulan Ude
Komsomolsk
Sakhalin Island
C. Lopatka
CZECH.
Budapest
Odessa
Rostov
Stalingrad
ASIA
L. Balkhash
Ulan Bator
MONGOLIAN REP.
Khabarovsk
KURIL IS.
RUM.
Bucuresti
Beograd
Don
Astrakhan
Caspian Sea
Aral
Syr
Tashkent
Tihwa
SINKIANG
GOBI (Desert)
Changchun
Shenyang
Pinkiang
Vladivostok
Hokkaido
Hakodate
NORTH
Black Sea
Istanbul
Tbilisi
Amu
Ho
Peiping
KOREA
SEA OF JAPAN
Honshu
JAPAN
4536
International Date Line
YUGO.
BULG.
GREECE
Athenai
Krete
Ankara
Baku
TURKEY
Mary
Samarkand
Ningsia
Tientsin
Tsinan
Seoul
Nagoya
Tokyo
Yokohama
Cyprus
SYRIA
LEB.
ISR.
Tehran
Kabul
CHINA
Yellow Sea
Osaka
Shikoku
Kyushu
Bengasi
Tripoli
MEDITERRANEAN SEA
Baghdad
IRAQ
IRAN (PERSIA)
AFGHANISTAN
Lahore
Indus
TIBET
Lhasa
Chengtu
Hankow
Nanking
Shanghai
EAST CHINA SEA
PACIFIC
4330
LIBYA
Alexandria
Cairo
Suez Canal
JOR.
Basra
KUWAIT
SAUDI ARABIA
Persian Gulf
PAKISTAN
Delhi
NEPAL
Chungking
Foochow
Changsha
Bonin Is.
(U.S. Adm.)
Tropic of Cancer
Asyut
EGYPT
Riyadh
Mecca
Karachi
Masqat
New Delhi
Ahmadabad
Ganges
Calcutta
Kunming
Canton
Taipei
Formosa
(U.S. Adm.)
2004
Hong Kong
Hanoi
Hainan
1822
MARIANA IS.
Wake I.
(U.S.)
ANGLO-EGYPTIAN SUDAN
Khartoum
ERITREA
YEMEN
ADEN (Br.)
OMAN
Bombay
ARABIAN SEA
INDIA
BAY OF BENGAL
BURMA
Rangoon
THAILAND
Bangkok
SOUTH CHINA SEA
Luzon
REPUBLIC OF THE PHILIPPINES
Manila
Guam
(U.S.)
1334
OCEAN
FRENCH EQUATORIAL AFRICA
Aden
Gulf of Aden
Socotra
GOA (Port.)
Hyderabad
Madras
Laccadive Is.
Palawan
Mindanao
Davao
Palau Is.
CAROLINE IS.
MARSHALL IS.
Addis Ababa
ETHIOPIA
FR. SOM.
BR. SOM.
It. SOM.
C. Guardafui
C. Comorin
CEYLON
Colombo
1572
Saigon
BRUNEI
N. BORNEO
SARAWAK
Halmahera
TERRITORY OF THE PACIFIC IS.
(U.S. Trust)
GILBERT IS.
(Br.)
Maldive Is.
(Br.)
Equator
MALAYAN FED.
Singapore
Borneo
Celebes
NEW GUINEA
BISMARCK ARCH.
(Austr.)
Rabaul
ELLICE IS.
(Br.)
BELGIAN CONGO
UGANDA
KENYA
Mogadiscio
Nairobi
Chisimaio
Mombasa
TANGANYIKA
ZANZIBAR
Dar-es-Salaam
Leopoldville
INDIAN
SEYCHELLES
(Br.)
Chagos Arch.
(Br.)
4021
Sumatra
INDONESIA
Djakarta
(Batavia)
Java
Timor
Lae
PAPUA TERR.
SOLOMON IS.
(Br.)
Sta. Cruz Is. (Br.)
ANGOLA
(Port.)
Lisboa
Elisabethville
Nyasa
Mocambique
Comoro Is. (Fr.)
C. d'Ambre
Diego Suarez
2098
Cocos Is.
(Austr.)
Christmas I.
(Br.)
TIMOR SEA
Darwin
C. York
CORAL SEA
NEW HEBRIDES
(Br. & Fr.)
Rotuma
(Br.)
FIJI
(Br.)
FED. OF RHOD. & NYA.
Lusaka
Salisbury
MOZAMBIQUE (Port.)
Mozambique Ch.
MADAGASCAR (Fr.)
Tananarive
Rodrigues
Mauritius
(Br.)
Reunion
(Fr.)
Townsville
New Caledonia
(Fr.)
Loyalty Is.
S.W. AFRICA
BECH. LD. PROT.
Pretoria
Johannesburg
Lourenco Marques
2471
Tropic of Capricorn
3217
Onslow
Rockhampton
Noumea
1739
(Fr.)
UNION OF SOUTH AFRICA
Durban
C. Ste. Marie
OCEAN
AUSTRALIA
L. Eyre
Darling
Brisbane
Norfolk I.
(Austr.)
Lord Howe I.
(Austr.)
1326
Capetown
Port Elizabeth
2266
Fremantle
Perth
Kalgoorlie
C. Leeuwin
Albany
Great Australian Bight
Newcastle
Adelaide
Sydney
Canberra
Melbourne
Bass Str.
North Cape
Auckland
North I.
1234
TASMAN SEA
NEW ZEALAND
Wellington
Amsterdam I.
(Fr.)
St. Paul I.
(Fr.)
N
1363
Tasmania
Hobart
Christchurch
South I.
Dunedin
Stewart I.
Bounty Is.
(N.Z.)
Pr. Edward Is.
(U. of S.A.)
Crozet Is.
(Fr.)
Kerguelen
(Fr.)
Auckland Is.
(N.Z.)
Antipodes Is.
(N.Z.)
Campbell I.
(N.Z.)
McDonald I.
Heard I.
(Austr.)
Macquarie I.
(Austr.)
Davis Sea
Drygalski I.
Shackleton Shelf Ice
C. Goodenough
C. Batterbee
Antarctic Circle
ENDERBY LD.
WILKES LAND
SO. MAG. POLAR AREA
C. Freshfield
Balleny Is.
C. North
C. Adare
VICTORIA LAND
ROSS SEA
Ross Shelf Ice
ANTARCTICA
THE WORLD
MILLER CYLINDRICAL PROJECTION
(MODIFIED MERCATOR)
SCALE ALONG EQUATOR
MILES
0 500 1000 1500 2000 2500
KILOMETRES
0 500 1000 1500 2000 2500
Capitals of Countries
Copyright by C.S. HAMMOND & CO., N.Y.
Steamship and Air Distances
234
NAUTICAL MILES
Important Overland Air Routes
Longitude East of Greenwich
0552
K 20° L 40° M 60° N 80° P 100° R 120° S 140° T 160° U 180°
1 2 3 4 5 6 7 8 9 10
80° 60° 40° 20° 0° 20° 40° 60° 80°

Laptevykh (sea)	S 2
Lebanon	L 4
Leeuwin (cape)	R 7
Lena (river)	S 2
Leningrad, U.S.S.R.	L 3
Léopoldville, B. Congo	L 6
Lesser Antilles (islands)	G 5
Lhasa, Tibet	P 5
Liberia	J 5
Libya	K 4
Lima, Peru	F 6
Lincoln (sea)	F 1
Lisboa (Lisbon), Port.	J 4
Lisburne (cape)	A 2
Little America	A 9
Loanda, Angola	K 6
Lofoten (islands)	K 2
London, Eng.	J 3
Lopatka (cape)	U 3
Lord Howe (island)	U 7
Los Angeles, U. S.	C 4
Lourenço Marques, Mozam	L 7
Lower California (peninsula)	D 4
Lower Tunguska (river)	P 2
Loyalty (islands)	U 7
Lusaka, N. Rhod.	L 6
Luzon (island)	S 5
Mackenzie (river)	C 2
Macquarie (island)	T 8
Madagascar	M 6
Madeira (island)	H 4
Madeira (river)	F 6
Madras, India	P 5
Madrid, Spain	J 3
Magadan, U.S.S.R.	T 2
Magellan (strait)	F 8
Magnitogorsk, U.S.S.R.	N 3
Malayan Federation	P 5
Malden (island)	B 6
Maldive (islands)	N 5
Manaus, Braz.	F 6
Manila, Phil. Is.	R 5
Mariana (islands)	T 5
Marie Byrd Land	C 9
Marquesas (islands)	C 6
Marrakech, Mor.	J 4
Marseille, France	K 3
Marshall (islands)	U 5
Mary, U.S.S.R.	M 4
Masqat, Oman	N 4
Mauritius (island)	N 7
McClintock (channel)	D 2
McClure (strait)	C 2
McDonald (island)	N 8
Mecca, Saudi Ar.	M 4
Mediterranean (sea)	K 4
Medvezhi (islands)	U 2
Mekong (river)	R 4
Melbourne, Aust.	S 7
Melville (island)	D 2
Mendocino (cape)	C 3
Mexico	D 4
Mexico (gulf)	E 4
México (Mexico City), Mexico	D 5
Miami, U.S.	F 4
Midway (islands)	A 4
Milano (Milan), Italy	K 3
Milwaukee, U. S.	E 3
Mindanao (island)	S 5
Minneapolis, U. S.	E 3
Minsk, U.S.S.R.	L 3
Mississippi (river)	E 4
Missouri (river)	E 3
Moçambique, Mozam.	M 6
Mogadiscio, Som.	M 5
Molotov, U.S.S.R.	M 3
Mombasa, Kenya	M 6
Mongolian Republic	R 3
Monrovia, Liberia	J 5
Monterrey, Mexico	E 4
Montevideo, Uru.	G 7
Montreal, Canada	F 3
Moosonee, Canada	F 3
Morocco	J 4
Moskva (Moscow), U.S.S.R.	L 3
Mozambique (channel)	L 7
Mozambique	L 6
Mukden (Shenyang), China	S 3
Murmansk, U.S.S.R.	L 2
Nagoya, Japan	S 4
Nairobi, Kenya	M 6
Nanking, China	R 4
Narvik, Norway	K 2
Natal, Brazil	H 6
Nelson (river)	E 3
Nepal	P 4
Netherlands (Holland)	K 3
New Caledonia (island)	T 7
New Delhi, India	N 4
New Guinea	T 6
New Guinea, N.E.	T 6
New Hebrides (islands)	U 6
New Orleans, U. S.	E 4
New Siberian (islands)	T 2
New York, U. S.	F 3
New Zealand	U 8
Newcastle, Aust.	T 7
Newfoundland (island)	G 3
Nicaragua	E 5
Niger (river)	K 5
Nigeria	K 5
Nikolaevsk, U.S.S.R.	S 3
Nile (river)	L 4
Ningsia, China	R 4
Nome, Alaska	A 2
Nordkapp (cape)	L 2
Norfolk (island)	U 7
North (cape)	U 7
North (cape)	U 9
North (island)	U 7
North (sea)	K 3
North America	E 3
North Borneo	S 5
North East Land	L 2
North Land	P 1
Northern Ireland	J 3
Norvegia (cape)	J 9
Norway	K 2
Norwegian (sea)	J 2
Noumea, N. Cal.	U 7
Nova Lisboa, Angola	K 6
Novaya Zemlya (island)	M 2
Novosibirsk, U.S.S.R.	P 3
Nyasa (lake)	L 6
Nyasaland and Rhodesia, Fed. of	L 6
Ob (gulf)	N 2
Ob (river)	N 2
October Revolution (island)	R 1
Odessa, U.S.S.R.	L 3
Ohio (river)	E 4
Okhotsk, U.S.S.R.	T 2
Okhotsk (sea)	T 3
Olekminsk, U.S.S.R.	R 2
Olenek (river)	R 2
Oman	M 4
Omsk, U.S.S.R.	N 3
Onega (lake)	L 2
Onslow, Aust.	R 7
Orange (river)	K 7
Orkney (islands)	J 3
Osaka, Japan	S 4
Oslo, Norway	K 3
Ottawa, Canada	E 3
Pacific Ocean (North)	B 4
Pacific Ocean (South)	C 8
Pakistan	N,P 4
Palau (islands)	S 5
Palawan (island)	R 5
Palmer (peninsula)	G 9
Palmer (archipelago)	F 9
Palmyra (island)	A 5
Panamá, Panama	F 5
Panama (canal)	E 5
Panama	E 5
Papeete, Tahiti	B 6
Papua Territory	T 6
Paraguay	G 7
Paramaribo, Sur.	G 5
Paraná (river)	G 7
Paris, France	K 3
Peace (river)	C 3
Peary Land	H 1
Pechora (river)	M 2
Peiping, China	R 3
Persia (Iran)	M 4
Persian (gulf)	M 4
Perth, Aust.	S 7
Peru	F 6
Peter I (island)	E 9
Petropavlovsk, U.S.S.R.	U 3
Philadelphia, U. S.	F 4
Philippines, Rep. of	S 5
Phoenix (islands)	A 6
Pinkiang (Harbin), China	S 3
Pitcairn (island)	C 7
Plata (estuary)	G 7
Poland	K 3
Port Elizabeth, U. of S. A.	L 7
Port Stanley, Falk. Is.	G 8
Portland, U. S.	C 3
Portugal	J 3
Praha (Prague), Czech.	K 3
Pretoria, U. of S. A.	L 7
Pribilof (islands)	A 3
Prince Edward (islands)	L 8
Prince of Wales (island)	C 3
Prince of Wales (island)	E 2
Prince Patrick (island)	C 2
Prince Rupert, Canada	C 3
Puerto Alegre, Brazil	G 7
Puerto Montt, Chile	F 8
Puerto Rico (island)	G 5
Punta Arenas, Chile	F 8
Quebec, Canada	F 3
Queen Charlotte (islands)	C 3
Queen Elizabeth (islands)	E 2
Quito, Ec.	E 5
Rabat, Mor.	J 4
Rabaul, Bis. Arch.	T 6
Race (cape)	G 3
Rangoon, Burma	P 5
Rawson, Arg.	F 8
Recife (Pernambuco), Brazil	H 6
Red (river)	E 4
Red (sea)	L 4
Regina, Canada	D 3
Réunion (island)	M 7
Revillagigedo (islands)	C 5
Reykjavik, Iceland	H 2
Rhodesia and Nyasaland, Fed. of	L 6
Riga, U.S.S.R.	L 3
Rio de Janeiro, Brazil	H 7
Rio Grande (river)	D 4
Riyadh, Saudi Ar.	M 4
Rockhampton, Aust.	T 7
Rodrigues (island)	N 6
Roma (Rome), Italy	K 3
Rosario, Arg.	F 7
Ross (sea)	A 9
Rostov, U.S.S.R.	L 3
Rotuma (island)	U 6
Rumania	L 3
Ryukyu (islands)	S 4
Sahara (desert)	K 4
Saigon, Viet-Nam	R 5
Saint Helena (island)	J 6
Saint John's, Canada	G 3
Saint Lawrence (gulf)	F 3
Saint Lawrence (island)	A 2
Saint Louis, Fr. W. Af.	H 5
Saint Louis, U. S.	E 4
Saint Paul, U.S.	E 3
Saint Paul (island)	P 7
Saint Pierre and Miquelon (islands)	G 3
Sainte Marie (cape)	M 7
Sakhalin (island)	T 3
Sala y Gómez (island)	E 7
Salekhard, U.S.S.R.	N 2
Salisbury, S. Rhod.	L 6
Salt Lake City, U. S.	D 3
Salvador (Bahia), Brazil	H 6
Salvador, El	E 5
Samarkand, U.S.S.R.	N 4
San Ambrosio (island)	E 7
San Francisco, U. S.	C 4
San Lucas (cape)	D 4
Santa Cruz, Arg.	F 8
Santa Cruz (islands)	U 6
Santiago, Chile	F 7
Santos, Brazil	G 7
São Francisco (river)	G 6
São Paulo, Brazil	G 7
São Roque (cape)	H 6
São Vicente (cape)	J 4
Saratov, U.S.S.R.	M 3
Sarawak	R 5
Sardegna (Sardinia) (island)	K 4
Saskatchewan (river)	D 3
Saskatoon, Canada	D 3
Saudi Arabia	M 4
Savannah, U. S.	F 4
Scoresby (sound)	J 2
Scotia (sea)	G 8
Scott (island)	A 9
Seattle, U. S.	D 3
Semipalatinsk, U.S.S.R.	P 3
Senegal (river)	J 5
Seoul, Korea	S 4
Severnaya Zemlya	P 1
Seychelles (islands)	N 6
Shanghai, China	S 5
Shenyang (Mukden), China	S 3
Shetland (islands)	J 2
Shikoku (island)	S 4
Shilka Amur (river)	R 3
Siam (gulf)	R 5
Siam (Thailand)	R 5
Sicilia (Sicily) (island)	K 4
Sierra Leone	H 5
Sidi Ifni, Sp. W. Afr.	J 4
Singapore	R 6
Sinkiang (prov.), China	P 3
Sitka, Alaska	C 3
Snake (river)	D 3
Society (islands)	B 6
Socotra (island)	M 5
Solomon (islands)	U 6
Somerset (island)	E 2
South (island)	U 8
South Africa, Union of	L 7
South America	F 6
South China (sea)	R 5
South Georgia (island)	H 8
South Orkney (islands)	G 9
South Sandwich (islands)	H 8
South Shetland (islands)	F 9
South West Africa	K 6
Southampton (island)	E 2
Spain	J 4
Spanish West Africa	J 4
Spitsbergen (Svalbard) (is.)	K 1
Sredne Kolymsk, U.S.S.R.	U 2
Stalingrad, U.S.S.R.	M 3
Starbuck (island)	B 6
Stewart (island)	U 8
Stockholm, Sweden	K 2
Sucre, Bolivia	F 7
Suez (canal)	L 4
Sumatra (island)	R 6
Surinam (Neth. Guiana)	G 5
Suva, Fiji Is.	U 6
Svalbard (Spitsbergen) (islands)	K 1
Sverdlovsk, U.S.S.R.	N 3
Sverdrup (islands)	E 2
Sweden	K 2
Switzerland	K 3
Sydney, Aust.	T 7
Syr (river)	N 3
Syria	L 4
Tacna, Peru	F 6
Tahiti (island)	B 6
Taimyr (lake)	P 2
Taimyr (peninsula)	R 2
Taiwan (Formosa I.)	S 4
Tallinn, U.S.S.R.	L 3
Tananarive, Madag.	M 6
Tanganyika (lake)	L 6
Tanganyika Territory	L 6
Tapajós (river)	G 5
Tashkent, U.S.S.R.	N 3
Tasman (sea)	T 7
Tasmania (island)	T 8
Tbilisi (Tiflis), U.S.S.R	M 3
Tchad (lake)	K 5
Tehran, Iran	M 4
Territory of the Pacific (islands)	T 5
Thailand (Siam)	R 5
Tibet	P 4
Tientsin, China	R 4
Tierra del Fuego (arch.)	G 8
Tihwa, China	P 3
Timor (island)	S 6
Timor (sea)	S 5
Titicaca (lake)	F 6
Tobolsk, U.S.S.R.	N 3
Tocantins (river)	G 6
Togo	K 5
Tokyo, Japan	T 4
Tombouctou, Fr. W. Af.	K 5
Tommot, U.S.S.R.	S 3
Tomsk, U.S.S.R.	P 3
Tonga (islands)	A 6
Torres (strait)	S 5
Townsville, Aust.	T 6
Trinidad (island)	G 5
Tripoli, Libya	K 4
Tristan da Cunha (island)	H 7
Tsinan, China	R 4
Tuamotu (archipelago)	C 6
Tubuai (Australes) (islands)	B 7
Tucumán, Arg.	F 7
Tunis, Tunisia	K 4
Tunisia	K 4
Turkey	L 4
Tutuila (island)	A 6
Ufa, U.S.S.R.	M 3
Uganda	L 5
Ulan Bator, Mon. Rep.	P 3
Ulan Ude, U.S.S.R.	R 3
Union of South Africa	L 7
Union of Sov. Soc. Rep	P 3
United States	E 4
Upernavik, Greenland	F 2
Uruguay	G 7
Uruguay (river)	G 7
Vaigach (island)	N 2
Valdivia, Chile	F 7
Valparaíso, Chile	F 7
Vancouver, Canada	D 3
Vancouver (island)	C 3
Venezuela	F 5
Veracruz, Mexico	E 4
Verkhoyansk, U.S.S.R.	T 2
Victoria (island)	D 2
Victoria (lake)	L 6
Victoria Land	T 9
Vienna (Wien), Aus.	K 3
Viet-Nam	R 5
Vilchek (island)	N 1
Villa Cisneros, Sp. W. Afr.	H 4
Vilyui (river)	R 2
Vilyuisk, U.S.S.R.	R 2
Viscount Melville (sound)	D 2
Vladivostok, U.S.S.R.	S 3
Volga (river)	M 3
Voronezh, U.S.S.R.	L 3
Wake (island)	U 5
Walvis Bay, S. W. Af.	K 7
Warszawa (Warsaw), Poland	L 3
Washington, D. C., U. S.	F 4
Washington (island)	B 5
Weddell (sea)	H 9
Wellington, N. Z.	U 8
West Indies (islands)	F 4
Western Samoa (islands)	A 6
West Spitsbergen (island)	K 2
White (sea)	L 2
White Horse, Canada	C 2
Wien (Vienna), Aus.	K 3
Wilkes Land	R 9
Windhoek, S. W. Af.	K 7
Winnipeg, Canada	E 3
Winnipeg (lake)	E 3
Wrangel (island)	A 2
Yakutsk, U.S.S.R.	S 2
Yalu (river)	S 2
Yangtze (river)	R 4
Yaoundé, Cam.	K 5
Yellow (sea)	S 4
Yemen	M 5
Yenisei (river)	P 2
Yokohama, Japan	T 6
York (cape)	T 4
Yugoslavia	L 3
Yukon (river)	B 2
Zanzibar	M 6

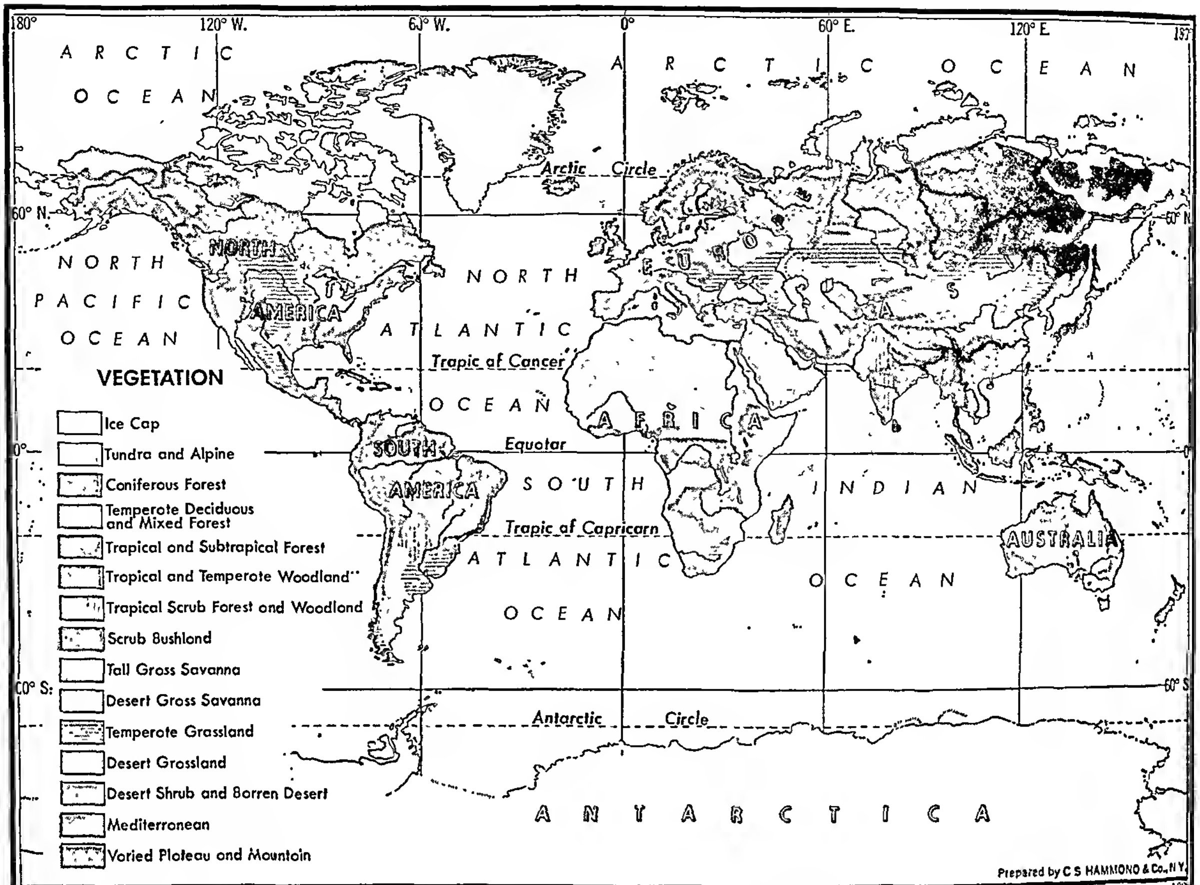
POPULATION AND CLIMATE AROUND THE WORLD

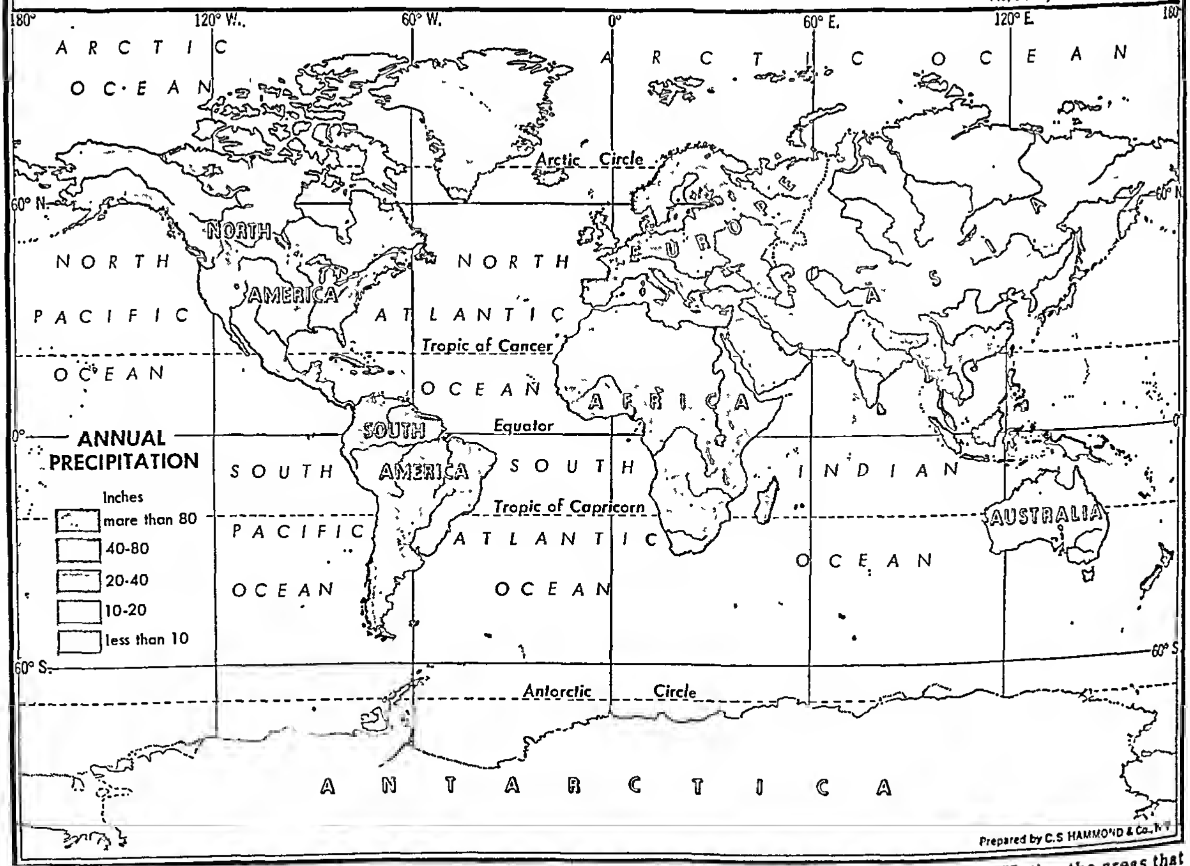




The top map shows how the people are distributed over the world. Comparison with the climate map reveals that people cluster where temperature and rainfall encourage the growth of useful plants, and few live where it is always cold or dry.

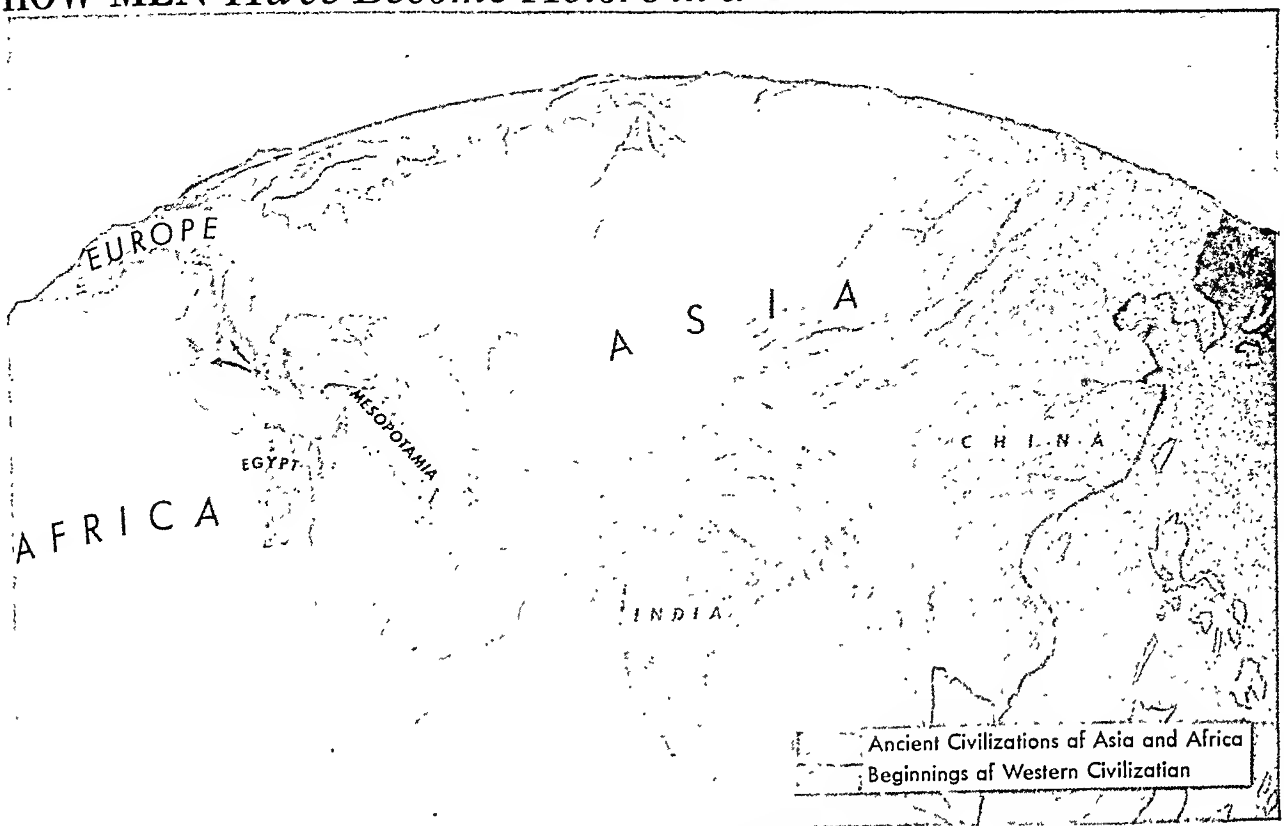
VEGETATION AND PRECIPITATION AROUND THE WORLD





The similarity between the patterns on these two maps shows how vegetation depends upon rainfall. Notice the areas that receive less than 20 inches of annual precipitation—the minimum needed for raising most crops without irrigation.

HOW MEN *Have Become Actors in a* SINGLE GREAT DRAMA



Principal Seats of Civilization in the Old World during the Period Called Ancient History

WORLD HISTORY. Today the history of each nation is intimately linked with the history of all nations. Wars that start in one corner of the earth tend to spread over the whole globe. The prosperity of a people may rise or fall in accordance with the buying power or the political opinions of another region halfway around the world. Social, economic, and philosophical ideas from all parts of the earth crisscross one another without regard to distance or boundaries. The welfare of mankind appears to depend upon the ability of people of all lands to understand one another.

From all this arises the desire to study general history, not as a confusing pattern put together from the several national histories, but as a single unified survey of the trends and movements that have affected and continue to affect the whole human race.

In this sense, world history deals with a comparatively new aspect of civilization. It dates from the time when modern transportation and communication brought all parts of the earth into contact with one another. But its roots of understanding reach far back into antiquity, for the way peoples behave toward one another is in great measure determined by the culture they have inherited from their distant past.

The Isolation of Ancient Times

In ancient times—during the centuries illustrated by the map above—there was no general world history. The centers of civilization in the Far East and those on the Mediterranean were hardly aware of one another's existence. Some slow exchanges between them took place on the material level—primitive inventions, domestic animals, and the like. But there was little or no transmission of ideas, no interaction between their moral and intellectual cultures.

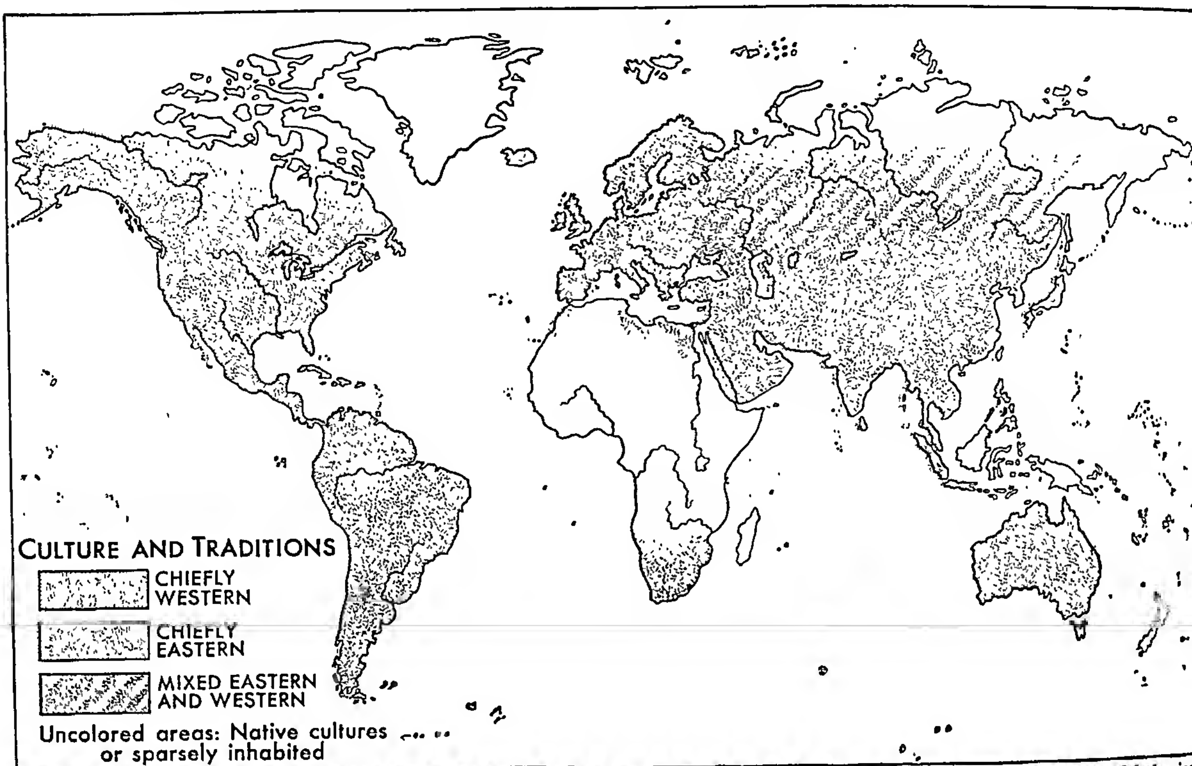
The early Asiatic and African civilizations were exclusive and self-limiting. They considered their neighbors as barbarians from whom they had little to learn. Their own culture, once achieved, became static and rigid, with little to inspire their people to further exploration or adventure. So they had little influence beyond their own borders.

Greek Reason Sets Men Free

It is not therefore in Egypt or Mesopotamia or India or China that we can find the beginnings of those forces that were destined to bring all men into "one world." We find them, instead, in ancient Greece. The Greeks had no great material power. They founded no lasting empire, not even a unified nation. But never has any other group of men generated so many ideas in so short a time. Underlying them all was a notion new to the world—the idea that *the human reason is a trustworthy guide in human affairs.*

Earlier peoples venerated the kind of traditional wisdom that grows out of the long experience of a race. Their laws and customs crystallized slowly and were handed down from generation to generation without explanation or criticism. Before the Greeks, no one seems to have realized that men might find the clues to wisdom within themselves. Before them, we find no trace of men trying to think things out for

BROAD CULTURAL DIVISION OF THE WORLD TODAY



The term "culture" as used here refers to the heritage from the past which tends to shape customs, tastes, standards of behavior, educational ideals, and the general outlook on life. It does not imply fundamental differences of quality in people.

themselves. We find no people testing new principles by the simple process of reasoned argument, and adopting those that proved acceptable to common sense.

This discovery made by the Greeks was enough to set men free. For if each man's reason was a valid guide, what right had any other man or group of men to dictate to him arbitrarily? The ideal government became one in which the leaders undertake to convince the people of the merits of their policies. And so democracy was born.

Out of the Greek faith in human reason, science also was born. For the Greek philosophers saw themselves, not as strangers in a mysterious and hostile world, but as a part of the nature that surrounded them. If there is reason in man, they argued, there must be reason in nature. They hunted for it. And so began physics, biology, medicine, scientific geography, and mathematical astronomy.

From their study of man's nature, they worked out many general principles for distinguishing between good and evil (ethics), principles of good government (political science), and principles of justice (law).

The Romans Inherit Greek Culture

All this wisdom developed by Socrates, Plato, Aristotle, and a score of others was not applied very well by the Greek people to their own affairs. Their literature, art, and architecture showed the taste and balance that are rooted in reason, but their political and social behavior was too often unruly and chaotic. It was through its influence on other peoples that Greek culture came to be a force in world history.

The Romans conquered Greece and became the heirs to its culture. It showed in their laws, which regarded all citizens as equals. It appeared in their great feats of engineering—the tremendous system of highways that covered Western Europe, the great aqueducts and arches and domes that dotted the empire. For where the Greeks had been theoretical, the Romans were practical in their science.

Above all, it revealed itself in the skill with which Rome conquered and governed its vast domain. Unlike most of the conquerors who had preceded them and many who followed them, the Romans did not as a rule destroy or degrade the peoples in the lands they took over. Wherever possible, they grafted Roman culture upon them, sent Roman citizens to live among them, and taught them the principles of law and order. So well did they carry out their task that, for centuries after the power of Rome was broken, Roman customs and ideas persisted in western Europe.

The Influence of Christianity

But long before Rome fell there entered into the Romanized world a force that was to outweigh all the others in importance. This was Christianity. There is no need to recite here the details of an influence so profound that even those who have rejected it as a religion still reckon the years and the centuries from the birth of its founder. Nor need we take into account the fact that Christianity has divided into numerous more or less opposed branches and sects. The aspect of the Christian influence with which we are now concerned is common to them all.

The Greeks had established the idea of human liberty on grounds of reason. The Romans had made free men equal before the law. Now came the Christian doctrine that holds, on the moral and spiritual plane also, all men are equal.

The Birth of Western Civilization

And so Western civilization was born. In the midst of all its violence and injustice, the fundamental idea persisted that any man might with luck achieve as much as any other man. Out of it appeared the explorers and discoverers, the scientists and statesmen, who boldly expanded the scope of Western influence until it spread over America and then encircled the globe.

This civilization, with the idea of individual freedom and individual responsibility at its heart, grew up and spread with extraordinary speed. Measure it against earlier history. In Egypt, between the building of the Great Pyramids and the reign of Rameses II about 1,500 years elapsed. During that time the Egyptians were scarcely aware of the mainland of Europe 600 miles away. And the reaches of Africa beyond the Nile Valley remained to them a land of fable.

Now measure off 1,500 years from the fall of Rome in A.D. 410, when ancient history is said to have ended. We find ourselves in the 20th century. Consider what happened to the world in that period, and you will gain a vivid impression of the dynamic power of the ideas that had been set in motion.

Growth in the Midst of Conflict

The culture of Western Europe was eclipsed for a time after the fall of Rome. This was the time called the Dark Ages, from about A.D. 400 to 800. But in the long run it proved a fruitful period. The Roman Empire had been thinly populated. The barbarians that had helped to overthrow it continued to pour in and provided a vigorous and varied soil for Western culture. The seeds of that culture were preserved in the monasteries. Missionaries spread Christianity throughout the former empire and far beyond, into Germany, Scandinavia, and the lands of the Slavs.

Presently Western Europe had regained sufficient cultural unity to enable Charlemagne in A.D. 800 to organize a large part of it into a new empire. This marked the beginning of what we call the Middle Ages. After his death, his empire was divided and subdivided. New notions began to form. Rival princes struggled for power. From that time to the 20th century the superficial history of Europe is a record of conflicts, many of them stimulated by the very speed at which Western civilization was moving. For ambitious rulers and governments often tended to regard the fruits of that civilization as the proper spoils of war.

If we look beyond the rulers and the governments at the people themselves, we see a different picture. In the Middle Ages we see cities growing and within their walls free men forming gilds and establishing the dignity of trade and labor. We see magnificent cathedrals rising. We see the beginnings of great universities. We see the unfolding of a scholastic philosophy which combines the principles of Aristotle and of Christian thought. It is expressed in complex and ponderous terms, but it is based primarily on the nature of man and his needs.

With the Renaissance we see great art and literature spring up anew, and the men who create it are not the noble and the powerful, but the sons of modest citizens whose genius has a chance to flourish in the stimulating atmosphere of their day. With the Reformation comes an outburst of new political as well as religious energy. Conflicts are bitter, but on the thoughtful side they center around the rights of the individual to freedom of thought and expression.

Development in the New World

The discovery and settlement of the New World by Western Europeans was another proof of the dynamic force of the civilization they had inherited and so vigorously developed. It proved other things as well. It showed that this civilization was hardy enough to stand transplanting and to flourish in a wilderness. It showed that its principles were rooted in the hearts of men and not merely embalmed in their customs. Within 300 years of the first settlements almost all of the New World colonies had cut the ties of government with the Old World. Yet the people on both sides of the Atlantic knew that fundamentally they were still of the same bent and the cultural ties remained as strong as before.

But from the point of view of world history, the most significant thing that was proved in the New World was the shallowness of the quarrels and rivalries that continued to set European nations at war with one another. For men and women from all those nations coming to the New World found they had enough in common not merely to avoid fighting but to mix and blend until the distinctions between them vanished. (*See also* Individual Freedom.)

New Doctrines in the Old World

In the Old World, however, the conflicts between governments grew sharper. The Industrial Revolution, by enriching the world, enlarged the stakes of victory and the possibilities of power. Peace and economic justice, desired by the vast majority, seemed far removed. Some men began to doubt that they could be achieved by following western traditions. Doctrines arose based on the concept that men cannot work out their own social destiny through *reason* but must be regulated and controlled by *force*. The force must be applied by dictators.

At that point the doctrines diverged. One called for the domination of the world by an efficient master nation. Out of it grew Fascism and Naziism. The other doctrine, Communism, called for the overthrow of all nations by revolution, and the setting up of an international dictatorship.

Fascism got its name and its first formal expression in Italy (*see* Fascism). But the idea of the master nation, with enough military power to challenge the world, had its rise when Prussia gained the upper hand in Germany in the 19th century. It was a prime cause of the two world wars. Communism also had a

German origin in the teachings of Karl Marx, but it found its first practical application in Russia (*see* Communism).

In trying to explain these facts, the student of world history turns back the calendar. He finds that for the first thousand years of Western civilization both Prussia and Russia lay outside its reach. Neither had experienced the gradual development of liberal traditions and democratic institutions. With tyranny and violence, however, they were familiar.

On the other side of the world, in Japan, another people adopted the industrial machinery of Western civilization without possessing its cultural traditions. The result was an outbreak of unbridled power.

The second World War destroyed the power of Germany and Japan, but the West soon found itself confronted by an even greater danger. While the West disarmed, Russia increased its military power. Most of eastern Europe quickly fell under Russian domination. In 1949 China was brought under the iron discipline of Communist rule. Around their vast frontier, the Communists pressed forward at point after point.

Communist doctrine and the speeches of Communist leaders left no doubt of Russia's designs to dominate the world. In the United Nations—set up to preserve the peace—Russia blocked efforts at disarmament and peaceful coexistence. To preserve freedom and prevent, if possible, another world war, the United States was forced to rearm and embark upon an active course of world leadership. Alliances had to be built up once more by the free nations, and the most costly arms race in history was begun. The danger was increased by the destructive power of new atomic weapons—particularly the hydrogen bomb.

REFERENCE-OUTLINE FOR STUDY OF WORLD HISTORY

History is a record of important events in human affairs, of the persons who helped shape the events, and of forces and trends which gave direction and character to what happened. In many classifications of human knowledge, history begins when the invention of writing made formal records available. All earlier occurrences are considered "prehistoric". In the following outline, the high lights of prehistoric times are presented as the forerunner of the historic record.

The article on History elsewhere in this encyclopedia explains how historians work to establish correctness of fact and understanding throughout the historic record. The article World History which precedes this outline sets forth the great forces and trends which have shaped human affairs and gives the outstanding landmarks in the historic record. The following outline points out additional facts which may be found throughout the encyclopedia. Still more information can be found from outlines with articles on the following important subdivisions of the historic record: Ancient History, Middle Ages, Renaissance and Reformation, Industrial Revolution, and History (Current Events).

The article History also has a 14-page listing of important dates, arranged by periods and countries for easy reference. It offers world-wide comparisons of events at any time in history.

- I. The peoples of the earth M-63-71, R-21-3. See also the Reference-Outline for Races of Mankind
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  - B. Early aids in living M-63, pictures C-325: fire F-73; stone (Paleolithic) tools S-401, M-69
  - C. Early thought and action controlled by custom, magic spells, and ceremonies C-325, M-33-6
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  - C. Beginnings of trade between peoples T-164-5
  - D. New aids brought by civilized living
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    2. Metalworking for better tools M-69
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- III. Nomads live on grasslands by herding G-170, M-69
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  - A. Earlier movements: Aryans into India and Persia I-67, P-155; Hittites into Asia Minor H-386; slow spread into Western Europe M-246
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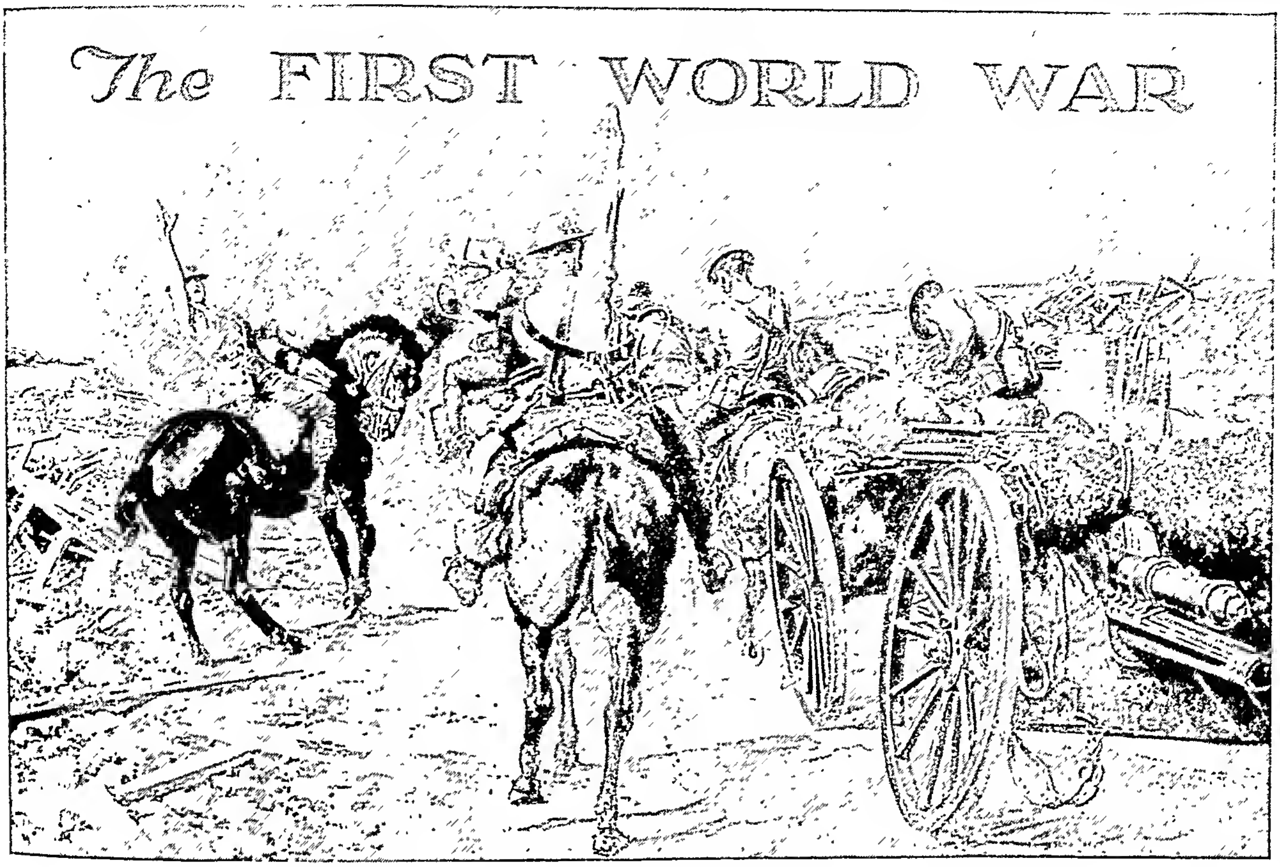


"Halt"—Road Blocked by Burst of Shell Fire in Path of Advancing Battery

WORLD WAR, FIRST (1914–1918). A map showing the countries at war during 1914–18 would include nearly all of Europe, Asia, Africa, and North America, with Australia and a large portion of South America. No previous war in history had involved so large a part of the earth's area and population. Against Germany, Austria-Hungary, Turkey, and Bulgaria were arrayed 24 nations: Serbia, Belgium, Russia, France, the British Empire, Japan, Portugal, Montenegro, Italy, San Marino, Rumania, Greece, the United States, Brazil, Cuba, Panama, Haiti, Guatemala, Honduras, Costa Rica, Nicaragua, Liberia, China, and Siam. Four others—Bolivia, Ecuador, Peru, and Uruguay—broke off diplomatic relations with Germany. The nations which remained neutral contained less than one-fourteenth of the world's population. The most important of the neutrals were Holland, Spain, Norway, Sweden, Denmark, Switzerland, Argentina, Chile, Colombia, and Mexico.

Not only in numbers involved, but in every other way the first World War made all previous wars small in comparison. The size of the armies and navies raised on each side would have astonished the conquerors of old. The amount of money spent seems fabulous. It has been estimated that the direct cost of the war was about 200 billion dollars, a sum which, if coined into silver dollars and piled up along the western battlefront, would make a wall 475 miles long, 2 feet thick, and 6 feet 8 inches high. The United States alone spent as much money as it did on all the expenses of the government from 1791 to 1914. Over 65,000,000 men were mobilized for the armies and navies, more than 8,000,000 lost their lives, and more than 21,000,000 were wounded. Guns, munitions, and other supplies were used up in quantities undreamed of in previous wars. To support the vast armies, unnumbered men, women, and children were called upon to "do their bit." (For a chronology of events, *see* **World War I** in the FACT-INDEX.)

How the War Started

The war began as a conflict between Austria-Hungary and Serbia. On June 28, 1914, the Archduke Francis Ferdinand, heir to the throne of Austria-Hungary, and his wife were murdered at Sarajevo, the capital of the rebellious Austrian province of Bosnia. The crime was committed by Gavrilo Princip, one of a group of young men who had planned together to carry it out. Princip was a Bosnian Slav, and so a subject of Austria-Hungary, but the plans had been made in Belgrade, the capital of Serbia; the weapons had come from the Serbian government arsenals; and a number of officers and officials of the Serbian government were involved in the plot.

For years the relationship between Austria-Hungary and Serbia had been unfriendly. The chief cause of trouble was that many of the people of Austria-Hungary, especially those in the provinces of Bosnia and Herzegovina, were Serbians and wanted to join that nation. The most ardent Serbian patriots wanted to unite all of the Serbs, and even all the

Yugoslavs (Southern Slavs), into one great state. Under these circumstances, Austria-Hungary did all in its power to suppress the ambitions of its Yugoslav subjects and to prevent Serbia from becoming strong enough to take them away by force. (*See* Bosnia and Herzegovina; Serbia.)

The Austrian government now decided to take advantage of the indignation aroused by the assassination of the Archduke and to settle its quarrel with Serbia. On July 23, the Austrian minister at Belgrade presented an ultimatum to the Serbian government, demanding that Serbia put an end to all anti-Austrian agitation within its borders, that Austro-Hungarian officials be allowed to take part in repressing such movements, and that the Serbian government dismiss from service any civil and military officers who might be designated by Austria. The demands were so severe that they give reason to believe Austria did not expect a satisfactory reply. Only 48 hours were allowed for an answer. Serbia accepted most of the Austrian demands and suggested that the others be referred to the Hague Tribunal or the great powers. Without further discussion, the Austrian minister left Belgrade and on July 28, one month after the assassination at Sarajevo, Austria-Hungary declared war.

All the European Powers Involved

This immediately set in motion the complicated system of alliances, treaties, and promises which the rival nations had been creating for years against just such an event—and within a week, all Europe was at war. To understand this swift result, it is necessary to examine the international situation at the time. Each of the states entering the war hoped that the final peace would solve its international problems and its international rivalries. For a long time statesmen and the people had awaited—with dread but at the same time with hope—the "inevitable" war which alone could solve many of these problems. Serbia, which had in the years before 1914, fought and won against Turkey and Bulgaria, had doubled its territory and saw in Austria-Hungary the last obstacle to Yugoslav unity. Austria-Hungary, with millions of dissatisfied subjects, was determined to maintain its position as a great power, and took the chance of complete destruction rather than submit to the risk of piecemeal disintegration. Russia's interest in the Balkans combined two main elements: the desire to control Constantinople and the straits from the Black Sea to the Aegean, and sympathy for the people of Slavic race and Greek Orthodox religion. Russia had been unable to give Serbian interests effective support in 1908 when Austria had changed the occupation of Bosnia and Herzegovina to annexation; in 1914, she felt that she could and must protect Serbia. In the opinion of many Russians, only the backing of Germany enabled Austria-Hungary to survive and it was Germany that blocked Russia in Turkey.

In the west, France and Germany were divided by the question of Alsace-Lorraine (*see* Alsace-Lorraine) and the enmity born of many wars. France alone could not risk a war with Germany, but Germany feared that in case of war with some other power, France would take the opportunity offered for another round in the age-old struggle for the Rhine. Of these international rivalries, the most recent was that of Great Britain and Germany. Until after the beginning of the 20th century, these two powers had been in general on peaceable and friendly terms. By then commercial competition had begun to weaken this friendship; and when Germany began systematically and persistently to build a great navy, England became suspicious and gradually hostile. In Germany, England was looked on as the chief obstacle to Germany's colonial ambitions and as the prime mover in what Germans regarded as the "encirclement" of their country. Minor causes of friction and misunderstanding multiplied until, in the opinion of some observers, the Anglo-German rivalry was the dominant factor in the international situation.

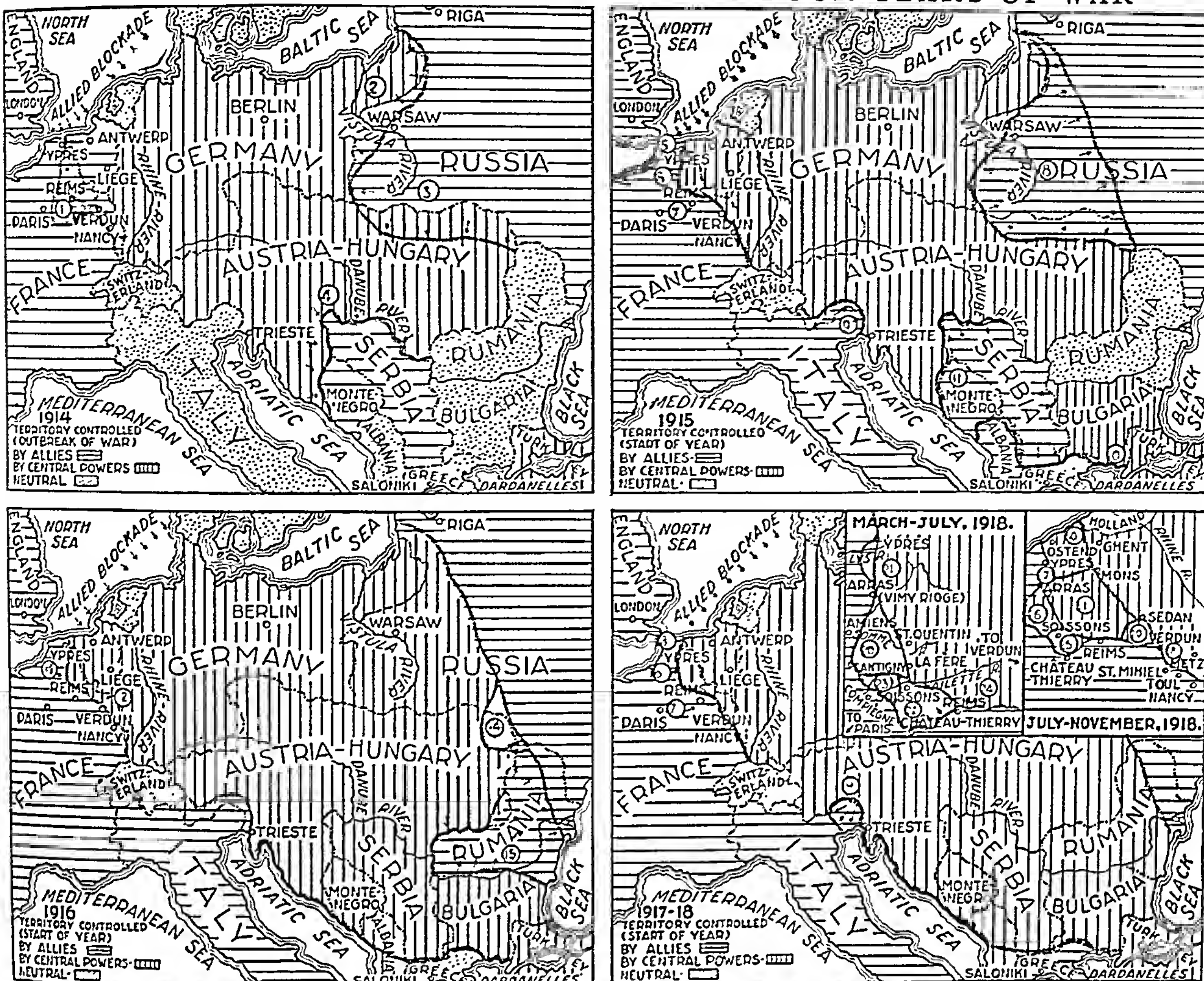
Years of diplomatic struggles with these problems had resulted in Europe becoming divided into two parties: the Central Powers—Germany and Austria-Hungary, with their doubtful ally, Italy, constituting the Triple Alliance; and the Triple Entente Powers, later called "the Allies"—Russia, France, and England. The Balkan states could be expected to take sides—Serbia with the Allies, and Serbia's enemies with the Central Powers. This complicated structure of alliances was brought into action July 28 by Austria's declaration of war, with Russia and Germany taking the chief rôles in the drama.

The Fateful Russian Mobilization

Even before learning of Austria's action, Russia had let it be known that she would not stand by and see Serbia crushed. Since 1879 Germany had been bound to help Austria-Hungary if attacked by Russia; and Germany immediately answered that if Russia offered armed intervention, she would support her ally. She suggested to France and England that they hold their ally Russia in check, but failed to put vigor in her representations made to Austria in compliance with the counter suggestion that she restrain her ally. Then the situation was made more explosive by Russia's announcement (July 28) of partial mobilization, followed by an order for general mobilization given July 30.

This order, added to the existing situation, made war practically inevitable. Relations between Germany and Russia had been tense for some time. Russia, with her huge population, was able to put into the field almost as many troops as Germany and Austria together. France, her ally, was ready with over a million more. The Russian army, however, was slow and unwieldy, while the German army was prepared for rapid, efficient mobilization and action. In view of this, the German military authorities argued that it would be folly to wait for lengthy diplomatic negotiations, thus giving Russia time to get her unwieldy military machine in motion. They insisted that it be peace or war immediately, so that, if it were

THE SWAYING BATTLE LINES DURING FOUR YEARS OF WAR



In grand strategy the first World War was fought on three fronts—on land, at sea, and on the "home front". At home, each nation struggled to maintain morale and obtain the necessary military supplies and munitions. None of this action can be shown on a map. At sea, the war consisted of a world-wide suppression of Austro-German maritime commerce. This action too can only be indicated. The blockade was not actually maintained by a line of vessels off the coast, but by armed ships patrolling all the seas. The British Grand Fleet prevented any attempt by the German navy to interfere with the blockade. In land fighting Germany held the upper hand for the first three years of the war. In 1914 (upper left-hand map) they carried the fighting into France, losing only the dotted area (1) yielded after the battle of the Marne. In the east, they pushed into Poland (2), while the Russians overran Galicia (3). The Serbian front (4) saw only local actions. During 1915 (upper right-hand map) the Germans defended themselves in the west against attacks at Neuve-Chapelle (5), in Artois (6), and in Champagne (7), while their main force overwhelmed the Russians (8). Italy joined the Allies, but accomplished little (9), while the British failed at Gallipoli (10). After the northern fronts were stabilized, Bulgaria joined the Central Powers, and they overran Serbia and Montenegro (11). In 1916 (lower left-hand map), Germany bid for victory at Verdun (12), and the Allies countered on the Somme (13), while Russia attacked in Bukowina (14). Rumania joined the Allies, but was overwhelmed (15). In 1917 (lower right-hand map) the Allies had the preponderance of man power, so Germany merely resisted major attacks at Arras (16), on the Chemin des Dames (17), and at Passchendaele (18), until cessation of northern fighting let her join the Austrians in routing the Italians at Caporetto (19). In 1918, Russia's collapse enabled Germany to make her supreme effort in the west (inset maps). Drives against Amiens (20), along the river Lys (21), to the Marne (22), and against Compiègne (23), extended her lines; and she was engaged in a fifth against Reims (24), when the Allies, at last strongly reinforced by Americans, turned the tide by the Aisne-Marne counter attack (25), the second battle of Amiens (26), the Albert offensive (27), the American Saint-Mihiel (28) and Meuse-Argonne operations (29), and a drive through Belgium (30). Additional territory (31) was yielded to avoid being outflanked, and the Germans were standing on the easternmost line shown, with a retreat to the Rhine their only hope, when the Armistice ended the war.

war, they could win the advantage of getting in a crushing first blow upon their slower opponents.

On July 31, therefore, the German ambassador at St. Petersburg (now Leningrad) presented an ultimatum, demanding that, within 12 hours, Russia cease all military measures and inform Germany that this had been done. As no reply was received, orders were issued on August 1 for the mobilization of the German forces, and hostilities began on the German-Russian frontier. At the same time that Germany sent the ultimatum to Russia, the German ambassador at Paris gave the French government 18 hours to reply to the question whether or not France would remain neutral in a war between Russia and Germany. The French government replied that France would act "in accordance with her interests"; and the French forces, too, were mobilized. On August 3, Germany formally declared war on France.

Belgian Neutrality Is Violated

As only a small part of the frontier between France and Germany was geographically adapted for maneuvering troops, and as that part was both too

narrow to accommodate great armies and was also strongly fortified, the German general staff, since about 1905, had planned to send the main attack on France through Belgium. On August 2, the German minister at Brussels received a telegram from Berlin ordering him to open a sealed envelope that had reached him several days earlier and to present the demands contained therein to the Belgian government. These demands, which had been drawn up by the chief of the German general staff on July 26, stated that Germany had reliable information that France intended to advance against Germany through Belgium. To anticipate hostile attack, Germany would be forced to enter Belgium. If no resistance was offered, it would evacuate the country at the end of the war and make good all damage caused by German troops. In case of resistance, however, Germany would treat Belgium as an enemy. The Belgian government refused these demands and appealed to France and Great Britain for support.

In a speech to the Reichstag on Aug. 4, 1914, Bethmann-Hollweg, the German chancellor, frankly admitted the illegality of his country's action:

> Gentlemen, we are now in a position of necessity and necessity knows no law. Our troops have occupied Luxemburg; perhaps they have already entered Belgian territory. Gentlemen, this is in contradiction to the rules of international law. . . . France could wait, but we could not. A French inroad on our flank on the lower Rhine would have been fatal to us. . . . The wrong—I speak openly—the wrong that we now do we will try to make good again as soon as our military end has been reached. When one is threatened as we are, and all is at stake, he can think only of how he can hack his way out.

England Is Drawn In

Until now, England's position had been uncertain; but violation of Belgian neutrality forced her to act. In 1839, after the separation of Belgium from the Netherlands, the five chief European powers (Great Britain, France, Prussia, Russia, Austria), had signed a treaty guaranteeing the independence and neutrality of Belgium. Four of the guaranteeing powers were now at war; and not only this situation, but other considerations, forced England to take sides. After 1904, Great Britain had drawn closer to France, and after 1907, to Russia, forming the Triple Entente. For several years the British and French military authorities, with the knowledge and consent of a few of the highest political leaders, had been making plans for a British expedition to the Continent in case the government should decide to join in a war on the side of France. In 1912, the naval authorities had arranged that the mass of the British navy should be concentrated in the North Sea while the French navy should move its strength to the Mediterranean.

Thus, although Great Britain was not bound by a definite treaty of alliance, as were France and Russia, the British government had virtually taken on a moral obligation to support France against Germany. On August 2, Sir Edward Grey, the British secretary of state for foreign affairs, informed the French ambassador at London that if the German fleet came into the English Channel or through the North Sea to undertake hostile operations against the French coasts or shipping, the British fleet would give France all the assistance in its power. The British cabinet and the British public were still divided as to whether or not they should aid France. The news of the German ultimatum to Belgium practically ended this division. Through the British ambassador at Berlin, Sir Edward Goschen, an ultimatum was sent to Germany calling upon her to respect Belgian neutrality. Goschen reported:

> I found the Chancellor very agitated. His Excellency at once began a harangue that lasted for about 20 minutes. He said that the step taken by His Majesty's Government was terrible to a degree; just for a word—"neutrality," a word which in war time had so often been disregarded—just for *a scrap of paper*, Great Britain was going to make war on a kindred nation who desired nothing better than to be friends with her. . . . .

But no satisfactory reply was received and at midnight, August 4, Great Britain was at war with Germany. The rest of the British Empire responded loyally to the call for aid and prepared to send troops.

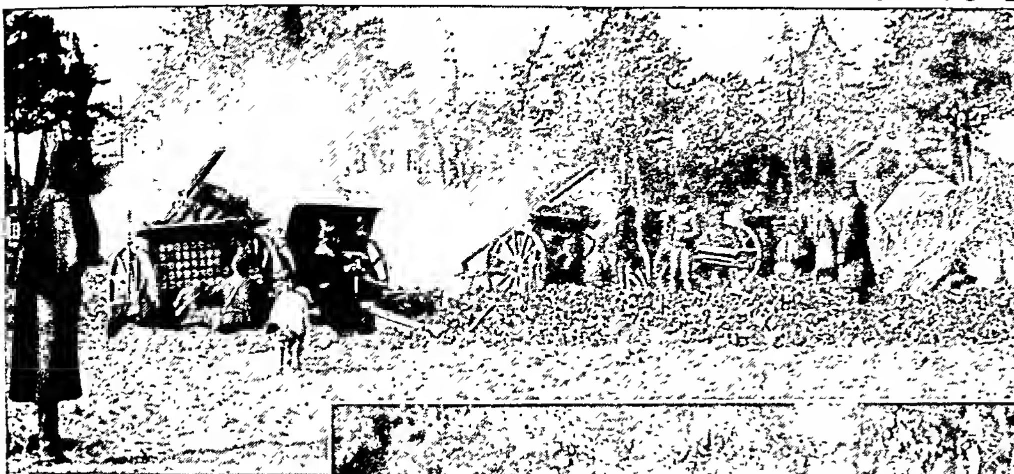
Italy Remains Neutral

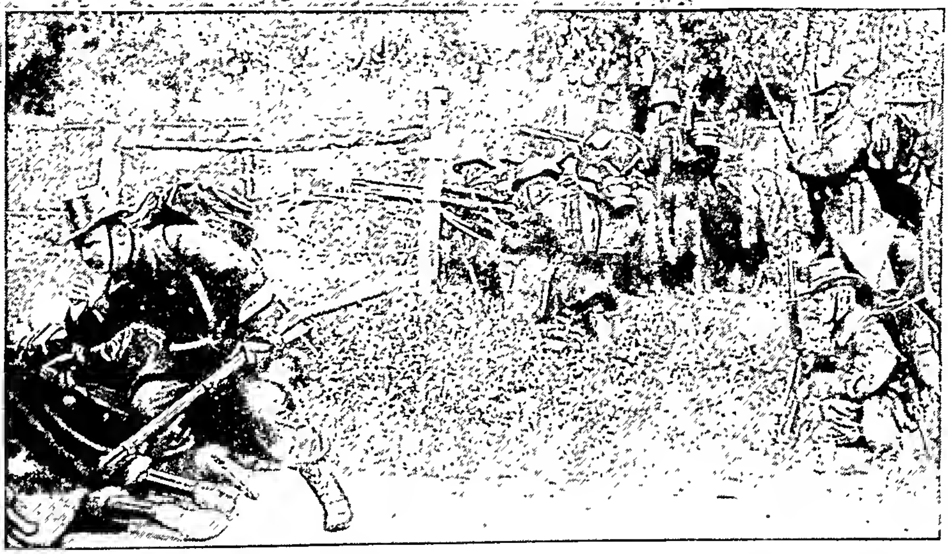
The one power concerned which did not leap into the fray immediately was Italy. In 1882, Italy had joined Germany and Austria-Hungary in the Triple Alliance, because her anger at the French occupation of Tunisia overbalanced her traditional enmity to Austria. But by 1900, anti-French feeling had subsided, and the two powers had compromised their Mediterranean colonial rivalries, Italy agreeing not to oppose the French in Morocco, and France recognizing Italy's interest in Tripolitania. In 1902, they had agreed that if either were attacked or found itself compelled to declare war in defense of honor or security, the other would maintain strict neutrality. In terms of practical politics, that really meant that except in case of an unprovoked attack by France on Germany, Italy probably would not support Germany. In 1909, Italy and Russia reached an understanding in opposition to Austrian policy in the Balkans.

It had been expressly understood from the beginning of the Triple Alliance that Italy, which had a long coast line exposed to naval attack, was not obliged to take part in a war against England. Italy renewed her signature to the Triple Alliance in 1912, but in 1914, the Italian government announced its neutrality on the ground that the circumstances which had brought on the war put her under no obligation to fight on the side of her allies. This freed France from the necessity of maintaining a strong force on her Italian frontier and so contributed to the later Allied success at the Marne.

In general, Italian public opinion approved the action of the government in not siding with Austria-Hungary, and many Italians favored joining the Allies to secure *Italia irredenta*—the territories in Austria-Hungary inhabited by people of Italian nationality. The Italian government now saw an opportunity to obtain some of these territories by agreement with

BELGIUM'S BRAVE BUT FUTILE RESISTANCE TO INVASION





When the German *feldgrau* (field gray) tidal wave of troops rolled over the Belgian border, the hopelessly outnumbered Belgians nevertheless fought. At the top a field-gun battery is firing in the streets of Hofstade, while an unconcerned pig wanders about, apparently not having heard that war has been declared. The lower picture shows members of the Belgian carbineers trying to stop German cavalry. But the German army could not be stopped.

Austria, as the price of her neutrality, and at the same time began to bargain with the Allies. This bargaining lasted through the opening months of the war, and the following winter.

The Question of War Guilt

During and for some time after the end of the war, it was generally asserted in most parts of the world that Germany had been primarily responsible for bringing on the catastrophe. In the treaty of peace, Germany was forced to accept the full responsibility for bringing on the war. Calmer reflection and fuller knowledge of the details of European history before the war and during the frantic weeks in July 1914, when it began, have led to a gradual modification of opinion. Students still differ in their interpretation of many facts; but they are completely agreed that responsibility for the war must be divided.

Europe in 1914 was in such a situation that any one of the international rivalries described might have produced a war. It merely happened to be the Near Eastern question which provided the cause. Probably none of the responsible leaders in any country wanted a European war, but none of them was capable of averting it. The mutual rivalries of the powers had created an atmosphere of suspicion and fear that made it impossible to discuss coolly and reasonably the questions at issue. In every country, the military authorities pressed for immediate action, fearful that their opponents might obtain the advantage of getting in the first blow; and every country contributed to produce the situation which resulted in war.

Germany cannot escape the responsibility for her support of Austria-Hungary in July 1914, for her declarations of war on Russia and France, and above all for her illegal attack on Belgium. If Austria had been willing to consider the Serbian reply as a basis for further negotiations; if the weak Czar had not yielded to the demands of the Russian militarists for general mobilization; if France or Great Britain had brought pressure to bear on their Russian ally to prevent this hasty action, the outbreak of hostilities might possibly have been postponed, and once postponed, might perhaps have been averted. All of the powers, then, must bear part of the responsibility, whether for their actions or for their omissions.

Strategy of the German Offensive

In making plans for a war against France and Russia, the German general staff faced the fact that the combined armies of those two powers were larger than the combined German and Austrian forces. They decided, therefore, that they could more easily obtain victory by crushing the better prepared enemy, France, and then turning against Russia. The plan of operations according to which the Germans acted in 1914 was based on one completed in 1905 by General von Schlieffen (chief of the general staff from 1891 to 1905). Schlieffen's plan was to leave a small force to face the Russians in eastern Germany and to use the mass of the German army against France. Of the troops on the western front, about one-seventh were to occupy the line from the Swiss frontier to the great fortress of Metz in German Lorraine, to engage as many French troops as possible and to retire slowly if

pressed hard. Six-sevenths of the available divisions were to carry out a great swinging movement, the left flank pivoting on Metz, the right sweeping through Belgium into northern France, to drive the French army before it and to crush it in the narrowing space between the Germans and the eastern frontier.

Schlieffen's successor as chief of the general staff, General von Moltke (the mediocre nephew of the great field marshal of Bismarck's time), retained the substance of this plan but modified it in details. Schlieffen had emphasized the importance of the strong right wing; his dying words are said to have been: "Make the right wing strong." But when an increase in the strength of the German army put additional divisions at the disposal of Moltke, he put them not on the right wing but on the left. In other details, too, he diverged from Schlieffen's conception.

To open the way into Belgium, Moltke planned that, as soon as war was declared, the German troops nearest the frontier should attempt to pass between the forts of the Belgian fortress of Liége in order to seize the town and prevent the destruction of the bridges over the Meuse River. In the meantime, heavy artillery fire would put the forts out of action. The first German attempt to reach Liége was checked by the Belgians on August 5, but during the next day a small body of troops, led by General Ludendorff in person, worked its way past the forts into the city. The forts resisted a little longer, but by the time the German mobilization was completed, great 42-centimeter howitzers had battered them to pieces. The delay had little effect on the course of the campaign. The Germans entered Brussels on August 20, shut up a large part of the Belgian army in the fortress of Antwerp, and moved on into France.

The French Defense on the Marne

The French army of about 4,000,000 was practically equal in numbers to the German, but only 1,500,000 of these were fully trained first-line troops. The plan of the French general staff was to mobilize the mass of the French army along the frontier from Switzerland to and including southeastern Belgium. The French were not surprised by the fact that the Germans came through Belgium; what they did not expect was that the Germans would swing so far to the north, or that they would use their reserves as first-line troops, and thus gain an added advantage in effective man power.

To meet the German attack, the French planned a counter offensive: a minor attack in southern Alsace for the moral effect of occupying part of the "lost province," and a main stroke at the center of the German army in Lorraine. The former was at first successful, and for a short time French troops stood on the Rhine, but the main attack through Lorraine was checked.

As General Joffre began to realize the real menace of the German plan, he started a hasty change in the location of his troops. Several French armies and the British Expeditionary Force, under General French, which had landed in France, advanced to meet the Germans at the Belgian frontier. But the French were driven back at Charleroi, and the British at Mons (August 23) and forced into a rapid southerly retreat. In the meantime the German left wing, which Moltke had made stronger than Schlieffen had intended, became impatient and unwilling to retire gradually before the French and to leave the glories of victory to the troops on the right. Permission was obtained to attack. Now, however, the French troops, which should have been held by the German left wing, retired behind the fortified line, reorganized, and many of them moved to the north.

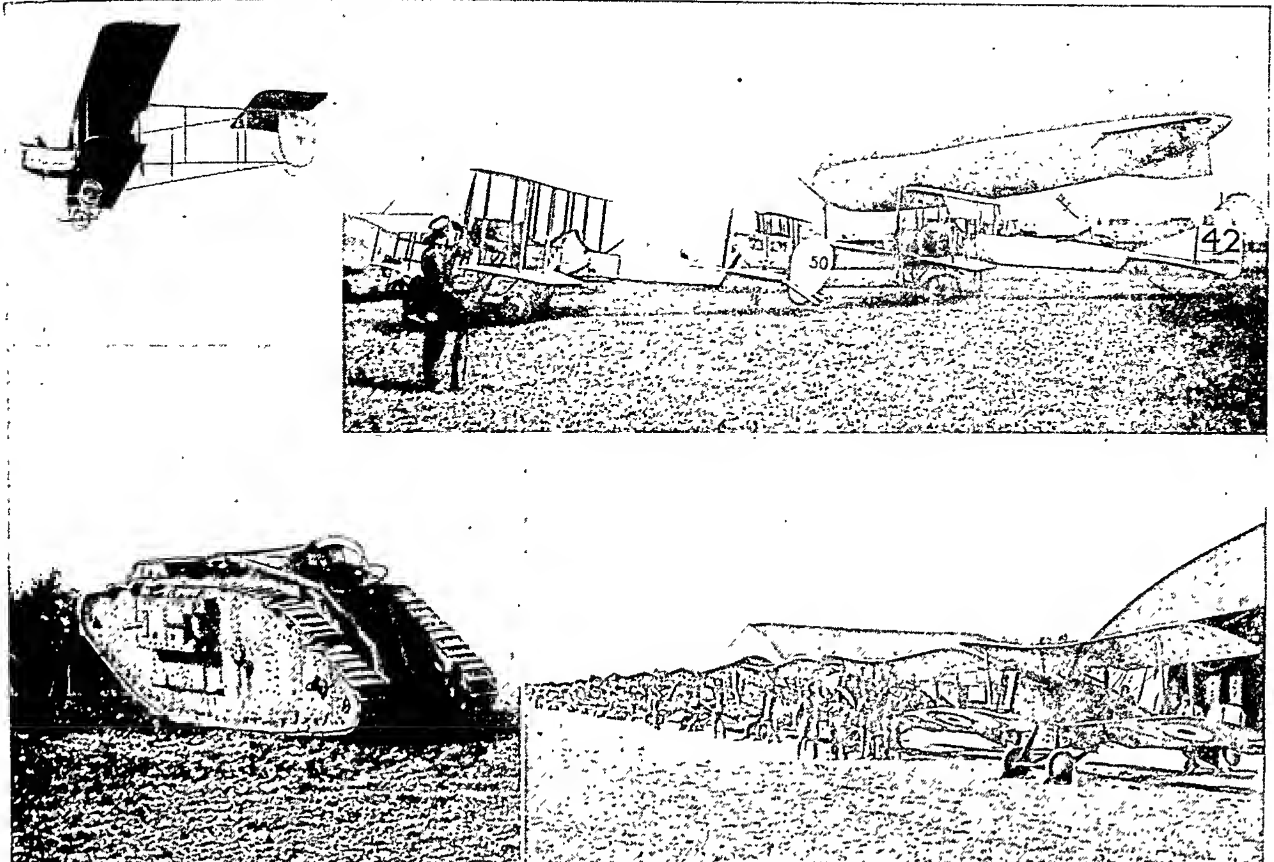
At the beginning of September, the German army on the extreme right was moving past Paris. Strenuous fighting, hard marches, and the natural difficulties of a campaign had led to some disorder in the German sweep. Headquarters were in Luxemburg, about 150 miles from von Kluck's army which formed the right flank. Both because of the general staff's inability to coördinate the movements of the armies, and because it detached troops for use against Russia, von Kluck now found himself without men enough to maintain contact with the army on his left and also envelop Paris. Consequently, when almost in position to strike Paris, he turned southeast to close the gap in the German front, thus virtually turning his back on the French capital.

General Gallieni, the military governor of Paris, saw the opportunity thus presented. He persuaded Joffre to let him use the newly formed Sixth Army to attack the exposed flank of the German army and to order an attack along the whole front. From the 6th to the 9th of September was fought the first battle of the Marne (*see* Marne River). The Germans retreated to the line of the Aisne and Vesle rivers. Thus their plan to crush the French army had gone awry, and their hopes for winning a quick victory in the war were blasted.

Stabilizing the Western Front

After a battle on the Aisne (*see* Aisne River), in which neither side could gain a decided advantage, the Allied and German armies tried to outflank each other. The result was the "race to the sea" which ended in a continuous battle line from the Swiss frontier to the North Sea. The Germans succeeded in extending their lines to the west of Ostend and Zeebrugge and also in taking Antwerp from the Belgians, in spite of British aid, on Oct. 9, 1914. This left to the little Belgian army only a few square miles of land in the extreme western corner of the country; there the Belgians successfully defended themselves until the end of the war, cutting the dikes and letting the water flow over the lowlands when other defenses failed. In the series of struggles (October 10–November 11) known as the first battle of Ypres (which the British "Tommies" insisted upon calling "Wipers"), the British beat oft a powerful German drive to seize the Channel ports (*see* Ypres). Winter then put an end to operations on the western front, with the armies

AMAZING DEVELOPMENT IN MACHINES FORCED BY WAR



Here we see the extraordinarily rapid progress that was made in the design of fighting machines. At the upper left is a Farman biplane, which was considered a good airplane in 1914. It was a pioneer air fighter, having been equipped with a machine gun. Beside it is a 1914 British airdrome, with crude machines and a small "blimp," or dirigible. Contrast them with the sleek, powerful airplanes used in 1918 (lower right). At the lower left is that marvelous product of the war, a "tank," really a small motorized fort, able to break through barbed wire, cross trenches, and overwhelm enemy infantry with machine-gun fire.

deadlocked in the trench warfare which was to last four years, without either side breaking through.

German Successes Against Russia

This stalemate in the west was somewhat offset for the Germans by their brilliant success in the east. The Russian mobilization under the Grand Duke Nicholas had been surprisingly rapid. The left wing of his huge force swept the Austrians almost out of Galicia by the end of September (leaving only the fortress of Przemysl holding out for several months), and the right wing sent two armies against east Prussia—one under Rennenkampf from the east, and one under Samsanof moving north from Poland. The frightened German commander in east Prussia, after a defeat at Gumbinnen August 19–20, was hurriedly replaced by Hindenburg, with Ludendorff as chief of staff, and these two, using plans already prepared by Colonel Hoffman of the staff, staged an amazing reversal of fortune. First an encircling movement, based on the village of Tannenberg, surrounded Samsanof's army, forcing its surrender August 31. The Germans then wheeled back against Rennenkampf, struggling through the Masurian Lake region, inflicted a terrific defeat (September 5–9), and forced the Russians to flee. Aside from heavy fighting to stabilize the front before Warsaw, this ended the 1914 campaign in the east. with the armies deadlocked as in the west. But the open nature of the country and its vast distances made it impossible for either army to dig in and defy assault; so the war could be, and was, forced into the open again in the following spring.

Events in Distant Lands

Aside from the main struggle, the most momentous event of 1914 in its direct effects, was Turkey's decision to join the Central Powers; it began hostilities October 29. This cut off Russia's easy sea communication with her allies—through the Dardanelles and the Mediterranean—a heavy blow, since Russia lacked the ability to supply herself with anything like the war munitions she needed. Furthermore, it threatened England's communications with the Orient through the Suez Canal, and compelled the Allies to use large forces throughout the war to prevent this disaster. Finally, it encouraged the Germans mightily, by making them believe that their great dream of a central European-Asiatic *bloc* ("Berlin-to-Baghdad") could be realized.

Japan cast her lot with the Allies, and declared war against Germany August 23. In direct effort, however, she contented herself with the siege and capture of the German Far Eastern stronghold at Tsingtao (August 27–November 7). British colonials in South Africa

WHERE "EASTERN FRONT" BATTLES WERE FOUGHT

This map shows the area in which the war was fought out between Germany, Austria-Hungary, Turkey, Russia, and the Balkan states—also the rivers, mountains, and the Black Sea-Mediterranean straits, which affected strategy in the East.

also organized efforts to oust their German neighbors, but had not accomplished much by the end of the year.

Novel Methods of Warfare

During the winter of 1914–15, every nation concerned struggled with the tremendous problems created by war on such a scale. "All former experience in war may as well be thrown on the scrap heap," declared the French general, Joffre, soon after the war began. For one thing, this was not a war of armies and navies, but of fighting nations. A single battle consumed artillery ammunition enough to fight an entire war of earlier days; all the railroads of northern France were scarcely able to keep the troops supplied. Since the universal service system had placed practically every able-bodied man in Continental Europe in the armies or navies, finding workers for the factories and transport systems promised to be a terrific problem. All this meant that civilian activities would have to be sharply curtailed, and the civilian population organized almost like an army—"every man, woman, and child in the right place."

The weapons exceeded anything ever devised before. Airplanes and submarines came into extensive use for the first time (*see* Airplane; Submarine). Huge guns—some of them throwing shells 70 miles—appeared, while field guns were used by the scores of thousands (*see* Artillery). Machine guns and extensive trenches, with barbed-wire entanglements, made infantry attack almost hopeless, unless the assailed position had been almost obliterated by artillery fire. Trench mortars, hand and rifle grenades, and steel helmets came into general use. Science provided delicate instruments for "listening in" on the enemy's telephone conversations over lines in the opposing trenches; radio was largely used. Later in the war "tanks"—giant armored tractors carrying machine guns and small cannon—lumbered into action, defying enemy bullets, smashing wire entanglements, crossing trenches, destroying machine-gun nests, and doing much to win the war for the Allies (*see* Tanks).

The Question of Gas Warfare

The German use of gas at the second battle of Ypres in April 1915 aroused special resentment. One of the Hague conventions (which all of the powers at this time in the war had accepted) prohibited the use of projectiles designed to spread asphyxiating gases. Technically, the release of chlorine gas from cylinders was not a violation of this law, but the Allies said it was contrary to the rule against the use of weapons or material calculated to cause unnecessary suffering. However that might be, both sides soon devised masks which offered effective protection against most kinds of gas, and both sides were soon using gases and gas-filled shells freely. (*See* Chemical Warfare.)

Millions of men were living and dying under conditions which mankind had never before faced. It is no wonder that these conditions bred violations of the rules of warfare by both sides. These were due, however, not to organized effort, but usually to the moral collapse of an individual, to the hysteria of the mob, or often to the sheer impossibility of obeying all the old rules. Many charges of "German atrocities" are now known to have been invented or exaggerated by Allied propagandists. Many such actions were incidental to the normal operations of war on a scale hitherto undreamed. But at the time the accusations aroused great indignation, and the severity with which the Germans applied the laws of war gained them the hostility of most of the world.

Campaigns of 1915

For their 1915 campaign the Allies decided to try to force Germany from her trenches in the west and defeat her, if possible. If they could not gain a vic-

tory, they hoped at least to keep enough German forces occupied so that the Russian "steam roller" could break in over the eastern frontiers. Von Falkenhayn, who had replaced von Moltke as German chief of staff, was convinced that the Allies could not break through the German trenches in the west; so he decided to stand on the defensive there and dispose of Russia.

The Allies were cheered by Italy's decision to enter the war on their side. In April 1915, she signed the secret Treaty of London, which offered her much more Austrian territory than Austria had been willing to cede; and on May 23, she declared war against Austria-Hungary. No declaration against Germany came, however, until August 1916.

The fighting of 1915 did not bring the results that the Allies had hoped for. The French spring attacks in Artois (May 9–June 18) and the British effort at Neuve-Chapelle (March 10) won local successes only, at terrific cost; while a powerful German counterstroke northeast of Ypres caused further trouble. This battle saw the first use of poison gas, on April 22. The gas routed some French colonials, and for a short time the road to the Channel lay open to the Germans. But the Canadian 1st Division, commanded by Gen. Sir Arthur Currie, entered the breach and held it firm. The Canadian division, after three months' training in England, had landed in France on February 11, and moved into the front line just in time to win distinction in this second battle of Ypres (*see* Ypres). In May and June it won further glory at Festubert and Givenchy.

In contrast, the German effort against Russia was brilliantly successful. Early in 1915 the Russians had poured up the Carpathians and through the passes into Hungary itself. Waiting until the Russians were well involved, the Germans under von Mackensen on May 2 broke through the center of the long line on the Dunajec River, and in two months of fighting (centering around Brest-Litovsk after July 15), drove the Russians out of Poland as far east as Pinsk, beyond the Pripet marshes, inflicting tremendous casualties and taking 750,000 prisoners.

The French meanwhile had recovered and on September 25 attacked in Champagne. The Germans, however, kept the French from more than local gains; then, when the situation was safe, turned south and in concert with Austria and Bulgaria, which declared war October 11, overran Serbia and Montenegro.

This won a clear road through to Turkey, which meanwhile had been holding out successfully against bungling Allied attacks, commencing with an attempt (February 19–March 18) by second-class warships to force the Dardanelles. The only result was to warn the Turks, and they were ready when on April 25 Sir Ian Hamilton landed a force of "Anzacs" (Australia-New Zealand Army Corps) on the narrow Gallipoli peninsula, for a combined land-and-sea drive upon Constantinople. The Gallipoli expedition proved to be a costly failure, and in January 1916 the troops were withdrawn.

A British expedition under Sir Charles Townshend which had advanced up the Tigris River from the Persian Gulf also met disaster and was forced to surrender to a vastly superior force of Turks (April 29, 1916) at Kut-al-Amara. In the region of the Caucasus Mountains, however, the Russians captured the important city of Trebizond on the Black Sea and cleared Armenia of the Turks.

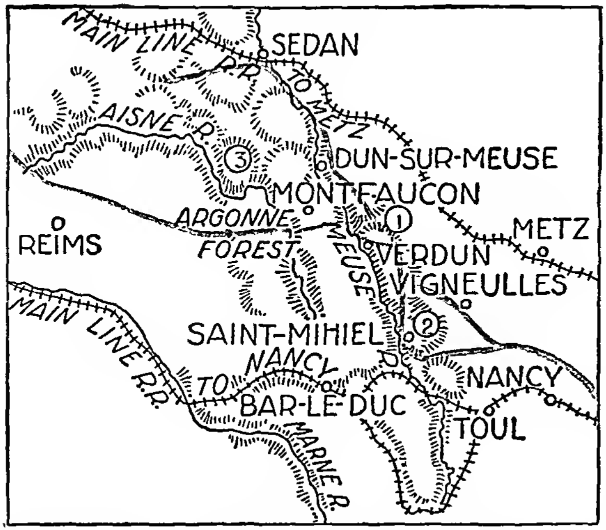
The War at Sea

While the attention of the world was focused on these titanic struggles on land, even more decisive, though much less spectacular, events were taking place at sea. No sooner had German wireless flashed the

LUCKLESS RUSSIANS WHO BATTLED VAINLY AGAINST GERMANY

These are typical of the armed "muzhiks," flung by the million under incompetent generals and with poor equipment, against Germany's skilfully led and superbly equipped armies. Appalling losses resulted, doing much to cause the Revolution of 1917.

VERDUN, A "STORM CENTER" IN THE WEST



This is the troubled area along the Meuse, west of the old Franco-German border, which saw much of the heaviest fighting of the war. In the center (1) is Verdun, scene of the terrific 1916 German attack, and below (2) is the Saint-Mihiel salient, won by the Germans in 1914, and retaken by the Americans in 1918. Above Verdun is the region (3) of the Meuse-Argonne battle, and at the top its objective, the railway through Sedan.

news of war than German merchant vessels everywhere sought safety in home or neutral ports, according to prearranged plans. The German fleet, knowing itself too weak to meet the British navy, also retired to safe waters behind the German island fortress of Helgoland and at the mouth of the Kiel Canal, where it remained securely "bottled up." Within a few days Germany's vessels and trade were practically swept from all oceans, except the Baltic, which the Germans controlled throughout the war. To be sure, a few commerce raiders such as the *Emden* led a spectacular career in the East Indies for several months before they were captured or destroyed; three British cruisers were sunk in September by submarines in the North Sea; and a German squadron led by Admiral von Spee defeated a smaller British squadron off Coronel, Chile, Nov. 1, 1914. Admiral Cradock, the British commander, went down with his ship. But that German squadron was destroyed by the British under Admiral Sturdee, near the Falkland Islands, Dec. 8, 1914; only one German ship, the *Dresden*, escaped. A few weeks later, Jan. 24, 1915, the British battle cruisers, commanded by Vice-Admiral Beatty, fought the running battle of the Dogger Bank with a slightly weaker German squadron, which succeeded in escaping to the protection of the high-seas fleet after losing the battle cruiser *Blücher*.

The Battle of Jutland

The German fleet itself did not challenge the Allied control of the oceans until the battle of Jutland, May 31, 1916. This was the most important naval conflict of the war. The British cruiser fleet encountered the German high-seas fleet off the Danish coast in the late afternoon. The mists were heavy, and by the time the British dreadnought fleet arrived on the scene, oncoming night made it difficult for the fleets to maneuver. The British fleet comprised 37 capital ships and 114 others; the Germans had 27 capital ships and 74 others. The British, commanded by Admiral Jellicoe, suffered heavier losses in ships and men, but Admiral Scheer withdrew the German fleet during the night, leaving the British with a costly but strategic victory.

Thus throughout the war the British held undisputed control of the surface of the sea, and maintained unbroken the blockade which many students believe did as much as all the armies to win the war. Lacking many important raw materials, such as rubber, cotton, and copper, and sufficient foodstuffs, particularly fats, Germany was doomed to slow but certain exhaustion, if she could be kept cut off from overseas supplies. Direct importation the British navy could, of course, and did, prevent. The one difficulty was that the neutral countries, Holland, Denmark, Norway, and Sweden, adjoining Germany could, unless prevented, import what Germany needed and resell to her. England met this situation by "rationing" the neutrals; that is, allowing them to import only as much as they themselves needed, so there would be no surplus for resale to Germany. Protests that this violated international law were met with the promise to settle damages later.

Germany's Submarine Campaign

One grim menace, however, threatened British maritime security. England could not exist more than a *few months without imported food and supplies*, so the Germans decided that while England was trying to starve them by blocking the surface of the sea, they would try to starve the English by submarine operations beneath the surface. This they could do provided they had enough submarines, could use them effectively enough, and—most important of all—if they were willing to violate existing international law. This would be necessary because international law provided that unresisting enemy merchant vessels were not to be sunk unless reasonable safety was provided for the crews, and that neutrals were not to be molested unless carrying contraband (materials directly useful in fighting). But a submarine, being highly vulnerable to ramming and gunfire from even small cannon, would risk destruction if it warned a vessel before torpedoing it; and lack of space prevented taking captured crews aboard. Neutral ships presented to Germany much the same problem the neutral countries did to England, and Germany foresaw that to make the blockade complete, she might later have to operate against all neutrals approaching the shores of England and France.

Admiral von Tirpitz, head of the German navy, finally won the German government to his views that the probable benefit of such a campaign would outweigh the dangers. On Feb. 4, 1915, Germany proclaimed that the waters around Great Britain and Ireland, including the whole of the English Channel, were in the war zone and that after February 18, enemy merchant ships met in this zone would be

WHERE ITALY FOUGHT BOTH NATURE AND THE FOE

Italy set herself to make a direct attack on Austria-Hungary in mountainous country. Above is a patrol clad in white for operating in Alpine snow, and the smaller picture shows the goggles and black grease used to guard eyes and skin against the glare of snow-reflected sunlight.

destroyed. Neutral ships, "in view of the misuse of neutral flags . . . and owing to the hazards of naval warfare" might also be endangered.

The first stages of the submarine campaign did not, however, produce material results comparable to the moral loss to Germany produced by such incidents as the torpedoing of a great passenger liner, the *Lusitania*, off Kinsale Head, Ireland (May 7, 1915), with the loss of 1,198 lives—men, women, and children, of whom 124 were Americans. More and larger submarines gradually made the campaign more effective, and by April 1917, when the United States entered the war, more than 3,000,000 tons of British shipping—16 per cent of her total 1914 merchant fleet—had been sunk, and as Admiral Jellicoe told the American naval commander, Admiral Sims, continuation of the losses would force England out of the war.

Military Events of 1916

After the disappointing results of 1915, the British government was reorganized on a coalition basis, with Asquith still premier but with Lloyd George assuming increasing importance (*see* Lloyd George, David). The British army was increased to 5,000,000 men, first by voluntary enlistment under Lord Derby's plan of national registration for reconciling the needs of war industries with the demands of the army, and then after January 1916, by conscription (*see* Kitchener of Khartum, Earl). By the end of 1915 there were 36 British divisions in France. Steps were also taken both in France and Great Britain to speed up the production of war material, so that in "the great push," as they called the intended offensive of 1916, there should be plenty of supplies available.

During 1915, Germany and Austria perhaps had dreaded most the possibility that Italy might bring decisive power to bear. But the Italians had chosen to deliver a frontal assault on Austria along the frontier; and the Austrians, aided by the mountainous terrain, had held their own except for trifling Italian gains, without having had to withdraw from the fight against Russia. With the Italians immobilized by their own choice of front, and Russia crippled, Falkenhayn felt that now the time had come to deliver the decisive blow against the French and British. For the effort, he chose the great salient in the French line at Verdun; and he proposed to break through, or, failing that, to keep drawing French reinforcements into the sector and there destroy them until her losses should compel France to sue for peace.

On February 21, under the command of the German Crown Prince, the attack came, preceded by an artillery bombardment more intense than any before known in war. For a short time the Germans swept everything before them; but as Verdun was about to fall, the defense, hastily reorganized by General Pétain, checked the advance. Many now urged Joffre to abandon the town and retire behind the Meuse. But Joffre knew that Falkenhayn would try to wear down his army, wherever it stood; so he forbade retreat, and for months the bitter struggle went on, without much change of situation (*see* Verdun).

On July 1, after a week's bombardment, the British came to the aid of France with their long-prepared Somme offensive. By the use of cannon in numbers heretofore unknown they gradually moved forward, and when winter ended the fighting they had driven a wedge of considerable size to a depth of nine miles into the German line. But this success was won at the cost of terrible losses, amounting to about 800,000 men (*see* Somme River).

During the summer the Italians had succeeded in crossing the Isonzo River and capturing Gorizia (August 9). But the gain was not worth their losses and their success did not affect the general situation. Far more important was the Russian offensive in Galicia

and Bucovina. Starting June 4, Brusilov drove the surprised Austrians into rout, and captured 300,000 men. Germany now had to support Austria and stand on the defensive on the western front. Brusilov's success also encouraged Rumania to join the Allies, her declaration of war coming August 27.

Rumania, however, was soon disposed of. As soon as cold weather stopped active fighting further north, Bulgaria, Austria, and Germany organized an attack under von Mackensen which swept the Rumanian army into the eastern end of the country, leaving Rumania's riches of oil and grain in the hands of the Central Powers. Aside from Gorizia, the only Allied success for the year was the start, December 12, of a British attack under General Maude against the Turks in Mesopotamia—an attack which drove through to the capture of Baghdad March 11, 1917.

The Halfway Point of the War

In many ways the winter of 1916–17 saw the end of the first phase of the war and the beginning of the second and final phase. For one thing, there was a wholesale change of leaders. Sir Douglas Haig had already (December 1915) replaced Sir John French as British commander-in-chief, and Lloyd George became premier of England. The French now replaced Joffre with Nivelle, and von Falkenhayn gave way to von Hindenburg for the Germans.

Far more important, however, were signs of collapse on the part of one great combatant, Russia, and of the entry of another, the United States. During the first two and one-half years of the war, the Russian army suffered many defeats because it was poorly equipped with arms and supplies. Russia's soldiers had entered the conflict enthusiastically and fought bravely. But they had lost heavily against the array of machine guns and the vast batteries of light and heavy artillery of the Germans. In fact, no other nation in the war suffered losses comparable to those of Russia. This was rightly blamed upon the incompetent and corrupt officials surrounding the Czar.

The Russian Collapse

On March 11, 1917, a revolution broke out in Petrograd (the name which had been given to the former St. Petersburg). Four days later the Czar abdicated. The new republican government under the moderate Socialist, Kerensky, decided to prosecute the war vigorously (*see* Russia). But the people were sick of the war; and groups of workmen and soldiers established councils (*soviets*). On November 9 this revolutionary party (the Bolsheviki) overthrew the Kerensky government and at once asked for an armistice. On March 3, 1918, the Bolshevik government signed a separate treaty of peace with the Germans at Brest-Litovsk. By the terms of this peace, the Russians lost Poland and nearly all the territory bordering on the Baltic Sea. They were also required to surrender a great area of land in the Caucasus Mountains to Turkey, and pay a huge war indemnity to Germany.

The United States Enters the War

As will be told in greater detail later, American public opinion had been slowly but steadily setting against Germany since 1914. Germany now took a step which resulted in bringing the United States into the war on the side of the Allies. With the knowledge that France and England could muster 3,900,000 men against her 2,500,000, Germany was persuaded that she could not attack. The only remaining way to press the Allies harder was to intensify the submarine campaign. This she did by declaring "unrestricted" submarine warfare in a zone surrounding the Allied coasts. That is, all vessels, neutrals included, were to be sunk without warning if found in this zone. To this violation of international law the United States responded by declaring war April 6, 1917.

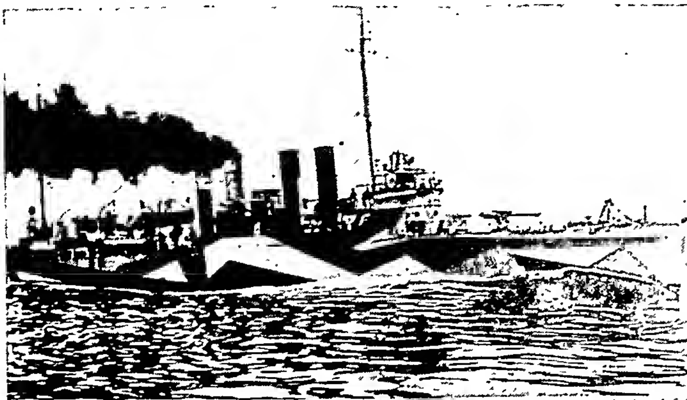
The Americans could help immediately with loans, by sending destroyers to help fight the submarines, and by sending battleships to reinforce the British Grand Fleet. But everyone knew it would take a year or more to organize an effective American army, and meanwhile the Allies felt strong enough to attack, encouraged by the fact that a large portion of the German army was in a vulnerable "bulge" between the Somme wedge on the north and the Aisne on the south. But before the fighting started, the Germans escaped this trap by devastating the district and retiring to a new defensive position, called by the Allies the "Hindenburg line."

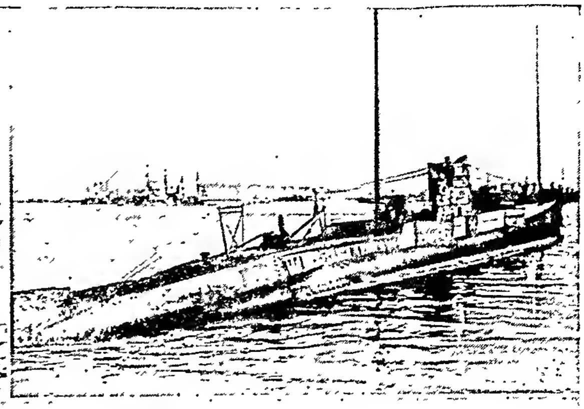
The Allies nevertheless attacked, and the British took Vimy Ridge on April 9 (*see* Arras). The Canadian corps in the center stormed the ridge, and held the east slope. The general advance continued for five days, and drove forward from four to six miles.

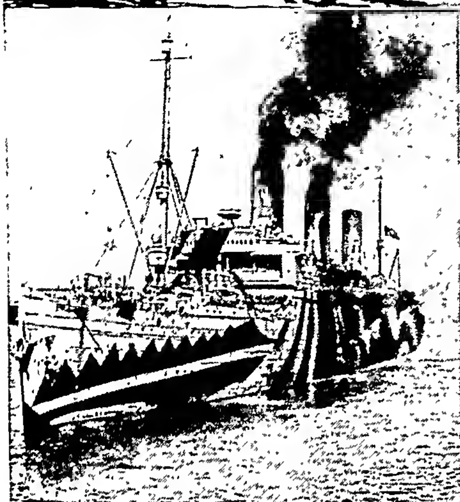
HOW TRENCHES LOOKED FROM THE AIR

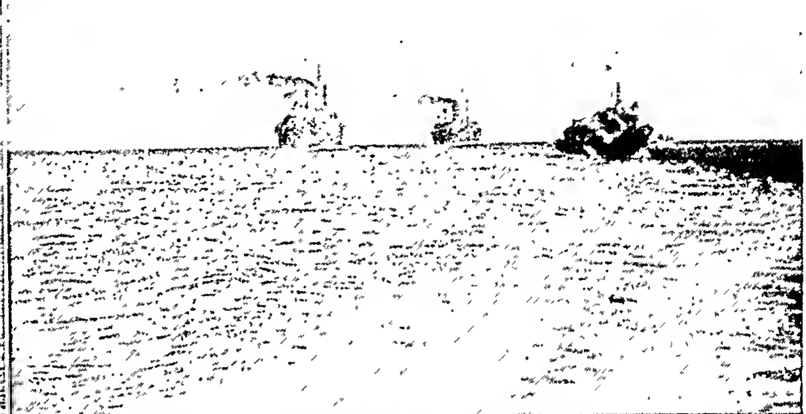
These German trenches were near Montsec, in the Saint-Mihiel salient, and faced to the right. Note the "bays," or dents in the line, to limit the effect of shell fire, and the shell holes where the Allies harassed the trench connecting these defenses with the woods. The wavy white lines are paths.

GLIMPSES OF VESSELS MOST USED IN THE WAR AT SEA









At the top are the types of vessel which saw most service on the respective sides—a German submarine (right), and (left), an American destroyer, representative of the vessels which proved best for suppressing submarines. The *Leviathan* (lower left), was America's largest troopship, and to its right, merchant vessels are anxiously voyaging to Europe, led by a destroyer. Note how naval camouflage aimed, not to conceal, but to distort the apparent shape of the vessel and make its course hard to determine ("confusion" camouflage), thus increasing the difficulty of aiming torpedoes at it.

The French attack under General Nivelle opened April 16, with an attempt to capture the Chemin des Dames ridge between Soissons and Reims. The French attack, however, had been delayed for three days, so that the advantage of the British pressure in the north was partly lost. The French made slight local gains, which were not worth the terrific losses, and by May 5 the offensive was definitely halted, with many French regiments practically in mutiny. This battle robbed the French of their offensive power for the rest of the spring and summer.

The British now had to carry the burden of attack while the French were recovering. For this purpose they selected the region in Flanders around Ypres, and commenced operations by capturing the Messines-Wytschaete Ridge (June 7–14), thus removing an awkward salient. The main offensive was launched in Flanders on July 31. As a diversion, to keep the Germans from transferring reserves to Flanders, the British tried several minor operations, one of which was the attack on Hill 70, near Loos, by the 1st and 2d Canadian divisions, on August 15. The Canadians were again conspicuous in the fighting around Passchendaele in October and November, when they fought for weeks in mud and slime to their hips. With very heavy losses, the British, Australians, and Canadians finally drove the Germans from Passchendaele Ridge. As a fitting climax to the series of battles, which are sometimes called the third battle of Ypres, the Canadians took the town of Passchendaele on November 6.

To end the year 1917 the British attacked farther to the south, near Cambrai, on November 20. Here a large force carried out a surprise attack in which tanks were first extensively used. It succeeded at first, but the British were in turn taken by surprise and lost nearly all the ground they had gained. In the meantime the French army had recovered its morale under its new commander, General Pétain. In August it retook the last of the ground lost at Verdun in 1916, and in October it successfully completed the Chemin des Dames operation of the spring. These various victories, however, not only were barren of strategic result, but had so whittled down Allied man power that the Germans, using troops released by the Russian collapse, would have the superiority in 1918.

Italy's Caporetto Disaster

Allied gloom was deepened by a rude shock received in Italy. There, during the summer, the Italians had made steady progress through extremely difficult

country toward their goal, the city of Trieste. But in their zeal to capture this city they left the line of battle on the upper Isonzo River poorly guarded. In this region, late in October 1917, the Austrians and Germans suddenly descended like an avalanche upon the Italian forces at Caporetto. A terrible rout was the result, which undid the work of two years, and cost the Italians about 265,000 prisoners and 2,000 cannon. Only on the line of the Piave River were the Italians able to stop the retreat, and for the next year this remained the battle line.

This battle also was notable for the successful use of propaganda by the Germans. Before the battle, Austrians in the front line had established almost friendly relations with the Italians, and airplanes had distributed friendly statements. The Italian soldiers had been impressed, and their leaders were not awake to the danger. Then suddenly the friendly Austrians were withdrawn, shock troops took their place, and disaster overtook the surprised Italians.

For the Allies, the one cheerful military episode of that gloomy period was the capture of Jerusalem December 9, after a strenuous campaign, by a British and Arab force led by General Allenby.

Germany's Chance for Victory in 1918

It was now clear to all that 1918 might bring victory to the Germans. True, Germany's most formidable bid for victory—her submarine campaign—had been curbed by destroyers and the convoy system of escorting merchant ships in small fleets surrounded by warships. But so much tonnage had been lost that the British did not see how they could spare ships to transport a large American army, even if one could be made ready to come. Moreover, the Germans now had a slight advantage in man power, and the skill to use it to good advantage.

The civilian and army morale of the Central Powers by now was feeling the pinch of the Allied blockade. But Allied morale was equally low. Their losses had been terrific; and while the Germans could draw consolation from many impressive victories, the Allies had only defeats or at most barren victories to show. Another impressive German success—particularly if it crippled military operations by such a blow as the capture of Paris or of the Channel ports—might well cause Allied morale to break, forcing a suit for peace on German terms before American man power could be organized and brought to bear in France.

The Opening Blow on the Somme

When the campaign of 1918 opened, the battle line of the western front ran in a southerly direction from a point on the North Sea near Ostend, past Ypres, Lille, Lens, and Cambrai, to La Fère on the river Oise. From there it bent gradually to the eastward past the battle-scarred cities of Soissons, Reims, and Verdun, and thence to the Swiss frontier. During the winter the Germans made the most elaborate preparations to win a military decision in the west before the full force of the United States could be felt in action. "If the enemy does not want peace," declared the Kaiser in December 1917, after it became evident that France and Great Britain would not accept a "German" peace, "then we must bring peace to the world by battering in with the iron fist and the shining sword the doors of those who will not have peace." This was not an idle boast, because the peace with Russia had just released a huge army of the Kaiser's veterans for service on the western front.

Since 1916 Hindenburg had been the chief commander of the German armies, with General Ludendorff as chief of the general staff and the real strategist of the vast German military organization. On March 21, 1918, the great offensive prepared by these two was launched in the devastated region of the Somme River, with terrific effect. In a few days the German troops overran the entire territory which the British and French had captured with such great labor and cost in lives during the previous summers. They even pushed the Allied troops back of the old lines for a total gain of 35 miles. About 2,000 Americans, in small units of engineers, medical officers, and aviators, did good service with the British in resisting this drive. The Allied losses in prisoners and guns were very large, and the roads of central France were again filled with homeless refugees from the invaded regions. In front of Amiens, however, the Allied troops held fast and thus prevented what threatened to be an overwhelming disaster. "The prize of victory must not and will not fail us; no soft peace, but one corresponding with Germany's interests," were the words of the Kaiser at this time.

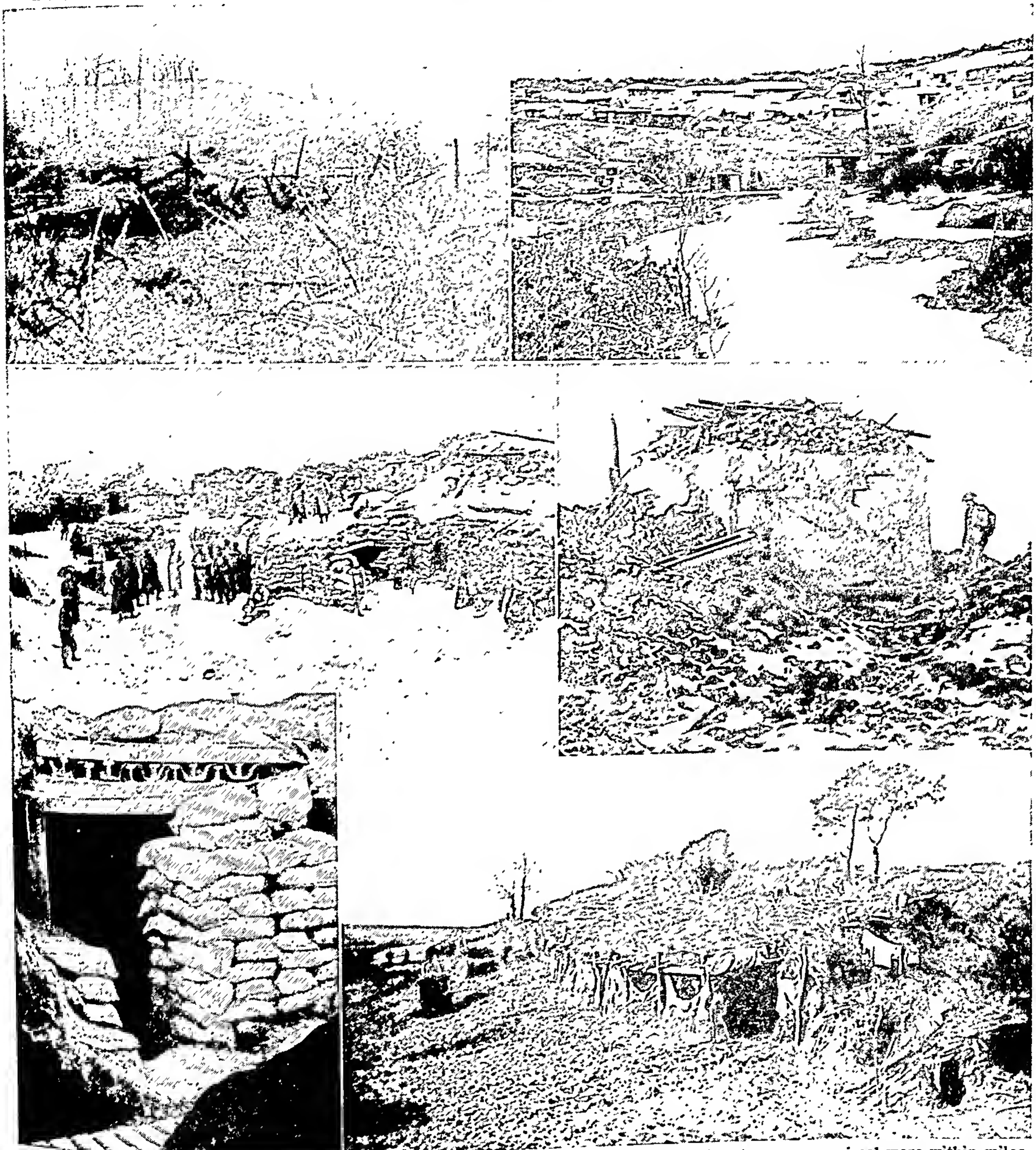
Foch Made Commander-in-Chief

It had been one of the most anxious weeks of the war for the Allies, whose chiefs finally recognized that something must be done to unify the activities of the Allied troops, in order to prevent if possible a break of the line when the terrible German onslaught should be repeated. It was unanimously agreed, March 26, 1918, that General Foch, now the commander of the French forces, should "coördinate" the operations of all the Allied armies on the western front, and three weeks later he was formally made commander-in-chief of the Allied armies.

So grave was the situation that American troops, although not yet battle seasoned, were now to be used in combat units. Thus far American troops, except in scattered training units, had not held front-line positions in any active sector; but within a few weeks American divisions were to operate in the battle line beside the French veterans.

The Somme offensive continued until April 6, when the German advance spent itself (*see* Somme River). On the 9th the Germans attacked again, along the Lys River south of Ypres, where they threw the British back for about ten miles. Then the fighting slowed down for about six weeks. It was only the lull before another storm, which broke on May 27. The scene was the old battleground of the Aisne River (*see* Aisne River), and the Germans were now under the personal command of the Crown Prince, who was put forward

LIVING UNDERGROUND TO ESCAPE AIRPLANES AND ARTILLERY



Probably visitors to the front were most impressed by its desert-like appearance, as though not a man or animal were within miles. Yet thousands of men would be present, concealed underground. The top pictures illustrate this with a view (left) of the grim front of a western front position, and (right) the "dugout city" on its rear slope (taken in 1919, with camouflage removed). French dugouts (middle left) in Champagne show white ground caused, not by snow, but by chalk dust. At the middle right is a German pillbox, or concrete machine-gun emplacement, captured by the Canadians. "Elephant" (corrugated) iron and rails protect the roof of the front-line dugout (lower left). Last, an artillery stable, with its roof covered to blend with the ground, shows "concealment" camouflage.

to deliver the blow that should crush the Allies and compel them to beg for peace. Like a flood the Germans overwhelmed the French positions between Soissons and Reims. For a week the French retreated, until the battlefront was again on the Marne River at Château-Thierry, only 44 miles from Paris. Then it was that large forces of Americans made their first appearance, and proved their fighting ability, notably at Cantigny, Château-Thierry and in counter attacks at Belleau Wood, Vaux, and Bouresches.

The Germans soon renewed the drive, hoping this time to capture Compiègne, thus placing themselves in position to strike the blow which would deliver Paris itself into their hands. But the French stopped

them after losing only a little ground, and the Germans now needed a breathing spell.

On July 15, they started another drive west of Reims, which developed into the second battle of the Marne (*see* Marne River). But now came the turn of the tide. General Foch had been biding his time, relieving veteran troops in quiet sectors with newly arrived Americans, and forming these veterans and the more seasoned American divisions into a general reserve. By attacking from one side of a salient, the Germans had laid themselves open to attack from the other—and on July 18 Foch seized this opportunity. French and American troops crushed in the western flank of the salient from Château-Thierry north, and the Germans had to run for the Aisne to avoid capture, yielding Soissons on August 2, with the 1st, 2d, 3d, 4th, 26th, 28th, 32d, 42d, and 77th American divisions among the pursuers. The 42d, 3d, and 28th previously had taken part in the resistance which stopped the attack of the 15th. This action was known as the Aisne-Marne operation.

The Allies Take the Offensive

The most important feature of Foch's offensive was that it did not stop. Before the Germans could recover from the Marne defeat, the British on August 8 opened a drive along the Somme. In this offensive (the second battle of Amiens), the Canadian corps, in the center, drove forward eight miles on the first day. This is believed to be the greatest single day's advance against resistance in the war. Two weeks later Albert and Bapaume were recovered. In little more than a month the Allies took 100,000 prisoners and the Germans were in full retreat.

Now the Allies had the Germans in a large-scale trap, if they could contrive to close it. The main German mass was west of a line from Antwerp to Metz, and their best hope of safety lay in retreating to this line. But behind the middle of the line lay the difficult wooded Ardennes Mountains; so the only avenues of escape were through Belgium, and to the south through Metz. These avenues the Allies now strove to close.

On October 9, after a fortnight of hard fighting, the Canadians took Cambrai. Even the little Belgian army, assisted by the British, now began a drive which in a few days won more territory from the Germans than the British had been able to gain in four months during the previous year. The recovery of French and Belgian towns, including Ostend and other North Sea coast cities, which for four years had been under German domination, now followed in quick succession. Lille fell to the Allies on October 17, and farther to the south the strongholds of La Fère and Laon were taken.

To the south, the main blow was entrusted to the Americans, who, for the first time, were to operate as an independent army. To clear the way for the final drive, the Americans (September 12–13), cut off the Saint-Mihiel salient, which menaced all communications in the Verdun sector (*see* Saint-Mihiel). The big drive through the Argonne Forest, then northward along the Meuse from Verdun to Sedan, then commenced, on September 26 (*see* Meuse-Argonne). Continuing through October and into November, the French and Americans moved northward towards Sedan, fighting every inch of the way over the roughest terrain, until they cut the railroad lines through Sedan, and the French entered the town November 7, thus severing the German army's line of supplies.

Collapse of Germany's Allies

While Germany was receiving these staggering blows, her allies everywhere were collapsing. Bulgaria, the last to join the German cause, was the first to leave it. For three years an Allied army at Saloniki, composed of miscellaneous detachments of British, French, Italian, and Serbian troops, with a force of Greeks under Venizelos, had been stationary and apparently useless. It was an army of considerable size, but its commanders hesitated to advance for fear of being attacked in the rear by the pro-German Greek king, Constantine. But on June 12, 1917, Constantine had been forced to abdicate, and Venizelos was able to bring the whole force of Greece to the side of the Allies. Suddenly, Sept. 15, 1918, the Allied army moved forward, and the Bulgarians, Austrians, and Turks fell back. In less than two weeks most of southern Serbia had been recovered, and Bulgaria was threatened with invasion. To avert this, Bulgaria asked for an armistice, which was signed September 30. She agreed to cease hostilities, to demobilize her army, and to surrender all means of transportation in Bulgaria for the use of Allied troops.

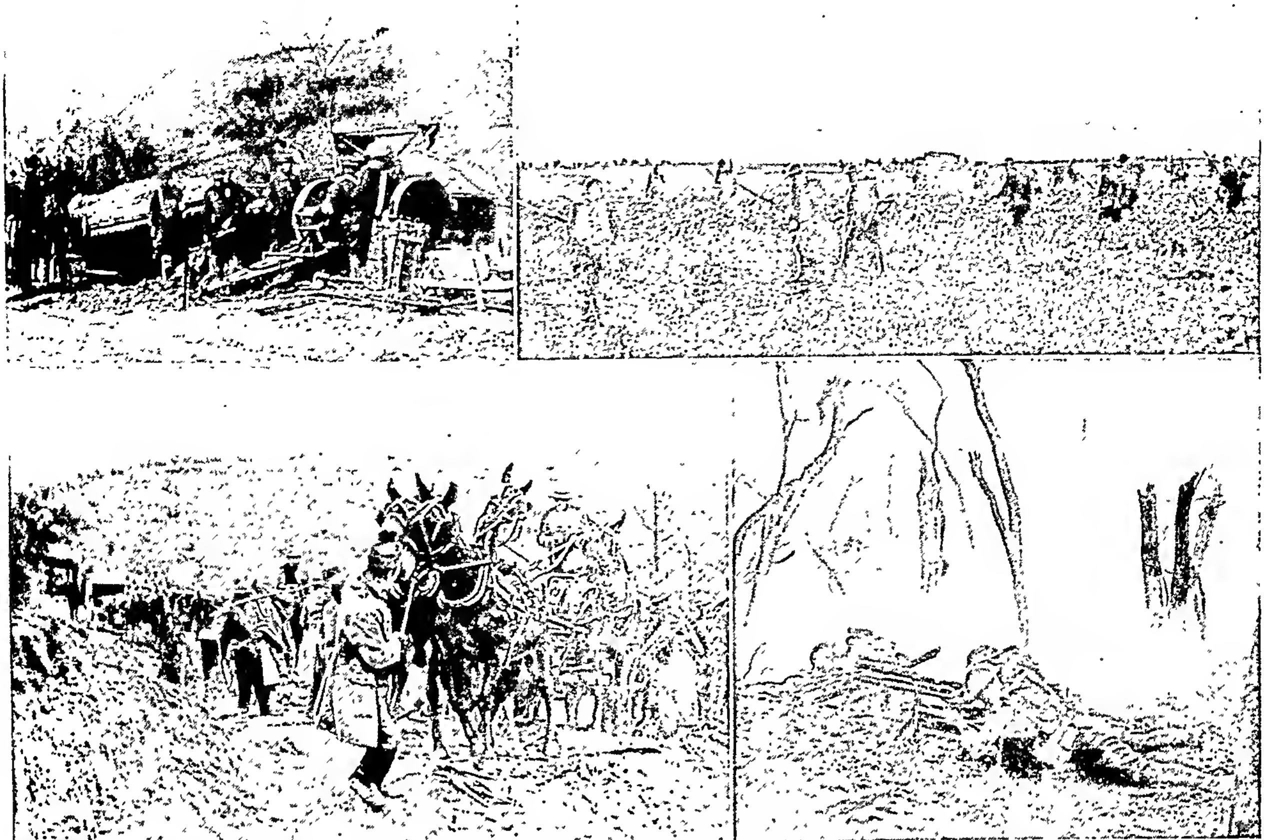
After the armistice with Bulgaria, the Serbian army continued its triumphant progress northward. Nish (Nis) and other cities fell, and the Austrians fled from Albania and Montenegro. Finally, after a campaign lasting less than seven weeks, Serbia was entirely cleared of Austrians.

A few days after this Balkan campaign began, General Allenby's army, which had taken Jerusalem, attacked the Turkish army in Palestine. Within two weeks it captured 71,000 prisoners and advanced 175 miles northward. Historic towns, including Damascus, Acre (Akka), Tyre, Sidon, Beirut, and Aleppo, fell in rapid succession. The Turkish government was in a panic and hastened to follow Bulgaria by surrendering October 31. The terms of the armistice imposed on her were similar to the Bulgarian conditions. In addition the Turks agreed to open the Dardanelles and Bosporus straits to the Allies.

The Italians "Come Back"

More dramatic perhaps than any of these campaigns—certainly far more important—was that begun by the Italians October 24. For a year the Italian army had apparently lain stunned behind the low banks of the Piave River. But a new spirit had now been breathed into the Italian ranks; the voice of pro-German and "defeatist" propaganda was stilled and the Italians longed to retrieve the disaster of the previous year. The time seemed propitious because

GLIMPSES OF FAMOUS AMERICAN BATTLES



At the upper left is a 155-mm. howitzer, firing from a temporary position during the Meuse-Argonne drive. At the upper right, Americans are going over the top in their attack on Cantigny. In the Saint-Mihiel operation, traffic congestion caused more trouble than the Germans did. Note (lower left) how one balky mule team blocks half a mile of vehicles. Last we see a 37-mm. gun crew in action against a machine-gun nest, during the terrific fighting of the Meuse-Argonne offensive.

the Germans could lend no assistance, being hard pressed in France and Belgium.

The Italians were successful beyond all their expectations. By advancing across the upper Piave in the battle of Vittorio-Veneto (October 27–30), they practically severed the connections between the Austrian troops on the plain and those in the mountains. The Austrians were straightway thrown into a hopeless panic. Within ten days over 300,000 of them surrendered, and the Austrian commander begged for a cessation of hostilities.

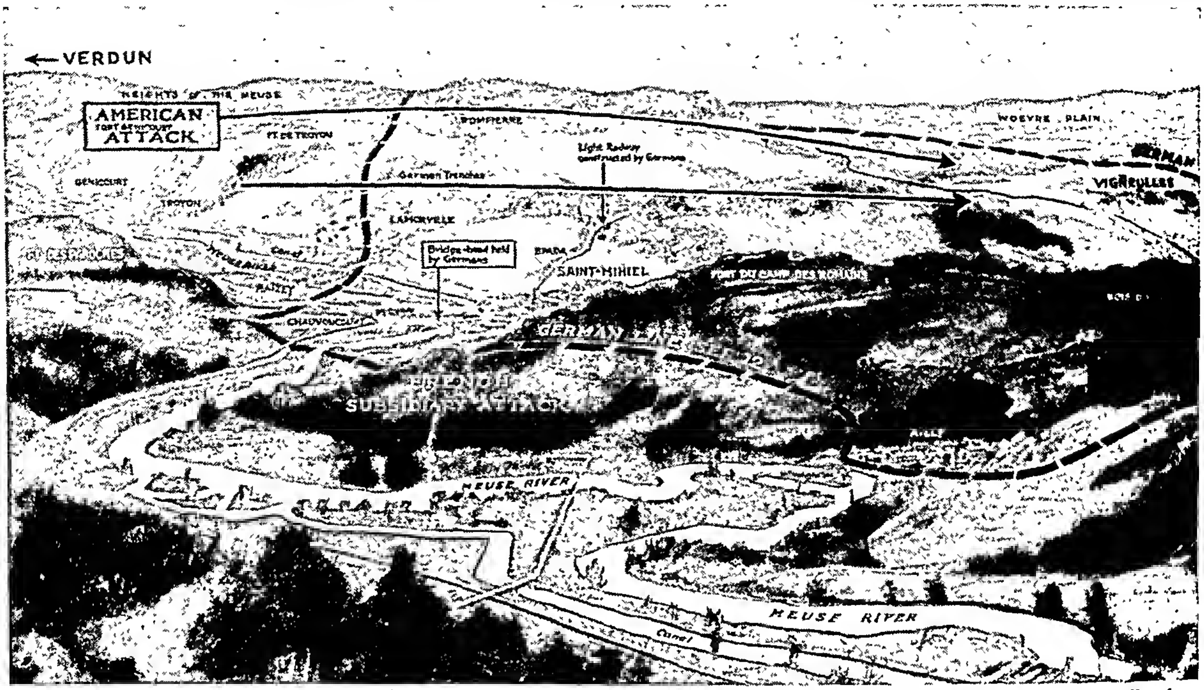
The armistice granted to Austria-Hungary on November 3, which took effect November 4, required her to demobilize her army, to surrender large strips of territory, to give up one-half of her military equipment and nearly the whole of her navy, to expel German troops from within her borders, and to permit the Allies free use of her railroads. These rigorous terms amounted to unconditional surrender.

The collapse of the Austrian army was accompanied by the collapse of the government at home. The long-expected break-up of the dual monarchy of Austria and Hungary, formed in 1867, came when Bohemia and other parts of the Hapsburg dominions, which for years had longed for freedom, joyfully proclaimed their independence. The heads of the proud and ancient house of Hapsburg, which for centuries had ruled over the destinies of a vast empire, fled to Switzerland for safety.

Collapse of Germany

Even before all these disasters, Ludendorff on September 29 had told the German rulers that the situation was hopeless. Prince Max of Baden was made chancellor, and on October 3 he requested an armistice. While the Allies were discussing terms, the "home front" within Germany was crumbling as well as the front presented by the armies. This was aided in no small measure by skilful Allied propaganda. Within Germany, this had been distributed for some time by the Independent Socialists, backed by money and other aid from Bolshevist Russia. In the spring, Allied airplanes had dropped leaflets over the Austrian lines, promising independence to national minorities. After July, maps showing Allied gains and strength were dropped upon German troops and in the larger industrial centers. Since the statements coincided with the soldiers' own experiences, they had wide effect. Disorder broke out in the German fleet at Kiel on November 3, and it spread rapidly to Hamburg and Bremen. The Socialists in Berlin refused to support the government any longer, and rulers of the two important kingdoms of Bavaria and Württemberg

PANORAMA OF THE SAINT-MIHIEL SALIENT, TAKEN BY THE AMERICANS



Since 1914 the Saint-Mihiel salient had been held by the Germans, like a pistol pointed at the heart of France. In their attempts to take it, the French lost hundreds of thousands of men, without result. General Pershing always wanted the first major American operation to be its capture, and after the Aisne-Marne counter attack had succeeded, Marshal Foch ordered this done. The salient had a front 50 miles long, and was 12 miles deep from its tip at Saint-Mihiel to its base on the line between Verdun (left) and Pont-à-Mousson (right). The artillery preparation started at 1:00 a.m., September 12,

abdicated. After hearing of these alarming events the Kaiser himself abdicated at Spa on November 9, and fled to Holland. Everywhere the hereditary princes of the German states resigned their crowns or were overthrown by revolution.

A temporary government was immediately formed at Berlin, which arranged for a national convention to be held at Weimar to form the republic.

The Armistice and Its Terms

By now the Armistice terms were ready and the Germans were called to receive them. A delegation crossed the lines and was taken to Marshal Foch's railroad traveling headquarters near Compiègne. At daybreak, November 11, they signed. Six hours later, at 11:00 a.m., the guns ceased to fire. (*See* Armistice.)

The terms of the Armistice were hard. President Wilson had warned the Germans that they would be such as "to make a renewal of hostilities on the part of Germany impossible." The German army was required to retire to a line about six miles east of the Rhine River, allowing the Allied troops to occupy the evacuated territory together with the three "bridgeheads" of Mainz, Cologne, and Coblenz; to surrender the bulk of the German fleet, including all submarines; to surrender vast quantities of military supplies, including 5,000 cannon, 25,000 machine guns, 5,000 locomotives, and 150,000 railroad cars; to renounce the treaties imposed on the Russians and the Rumanians earlier in the year; to surrender all their prisoners; and finally to agree to pay for damage done.

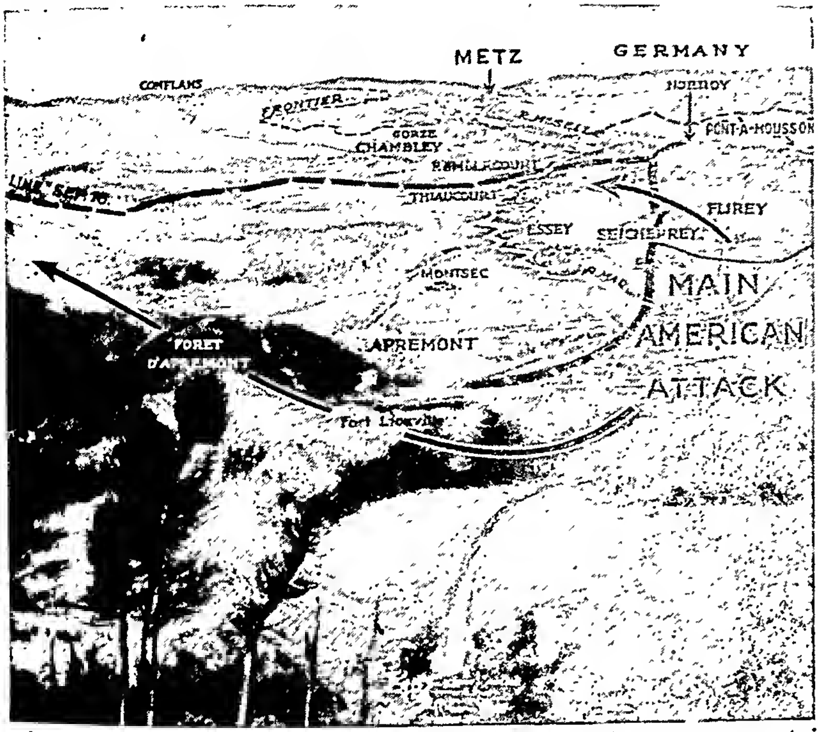
The Germans commenced withdrawal at once, and the Allied troops followed closely without trouble. The war now definitely was at an end. There remained the colossal task of planning an acceptable peace.

How the War Came to the United States

PRESIDENT Washington took the stand that the wars of Europe ought not to be considered as the business of the United States. In 1793, when France and England renewed their long struggle for supremacy in Europe, he declared neutrality, promising to remain friendly with both, and to give aid to neither. As a neutral, he claimed for the United States the right to continue its trade with both warring countries, except in so far as international law clearly permitted them to interfere with it. (*See also* Blockade; International Law.)

One hundred and twenty-one years later, President Wilson found an unbroken precedent for proclaiming neutrality when in 1914 the World War came to threaten civilization with destruction. It was hard for Americans to believe the fact of war in 1914. That a European war should involve the United States was scarcely to be imagined. And it was easy to believe that the cause of the great struggle was the rivalry of the European nations, their race for imperialistic possessions, and their competition in armies and navies that had turned Europe into an armed camp.

IN THEIR FIRST "ARMY SIZE" OFFENSIVE



and at 5:00 a.m. the infantry went over the top. The main body assailed the southern face, and included in its mission capture of the dominating hill near the village of Montsec, from which since 1914 the Germans had watched every movement in the low-lying Allied position. A supporting attack at the north closed escape that way, and at 3:00 a.m. on September 13, patrols from the two attacks met at Vigneulles.

The United States, with no compulsory military training, had a small standing army, and a navy none too large for the two coasts that had to be defended, and no thought at all of an offensive war. To keep out of the European war was the expectation of a people who believed that wars are generally wrong; it was even more the hope of the multitudes, newly arrived in the United States, whose relatives were in every country of Europe, and whose affections and loyalties, apart from their greater loyalty to the United States, were with the nations of their ancestors.

How the first World War revealed itself to them all, how the conviction arose that the Central Powers were in the wrong, how it became clear that the United States could not remain a neutral and be safe, make up the story of how the war came to America.

How America Felt When War Broke Out

The quarrel of Austria with Serbia seemed too slight a cause to provoke so great a war. When Germany suddenly crossed the frontiers of Belgium, and wrecked a small and friendly country, she showed that the German armies were the best prepared in Europe; but it seemed in the United States that a great wrong had been done, and that every peaceful nation ought to sympathize with Belgium. It was soon believed that Germany and Austria had prearranged the war, launching it when they were ready. Maps on sale in German book shops, showing the gains that Germany expected to make, strengthened this belief.

After the war, the historians showed that the war was indeed due to the rivalry of the European nations, and that Germany, careless at first, tried too late to stop it. But she invaded Belgium on her way to France; and every shipload of food sent by America to feed the Belgians made it easier to believe in German guilt. Both the Allies and the Central Powers tried by propaganda to convince the United States that they were entirely in the right. Because the Allies, Great Britain and France, controlled the cables and the mails, it was hard to get the German side of the story before neutral countries. Germany was charged with terrible atrocities committed against innocent men, women, and children; these could not be verified, during the war or since. But it was easy to believe them; and the devastation of Belgium was a reality. Opinion in the United States, content to preserve the political neutrality of the country, tended to hold that if the Allies were not entirely right, Germany at least was wrong. The militaristic government of Germany was in contrast with the more democratic forms of government in Great Britain and France. This contrast, too, suggested that here was a war of military autocracy against democratic governments, and that the place of the United States was on the side of the Allies.

More certain matters affecting American opinion were the inconveniences to which United States ships and cargoes were subjected. The Allies searched vessels, interfered with the mails, and stopped trade with neutral countries in Europe on the ground that the goods might be intended to go into Germany. Their acts were irritating, and often illegal. German sympathizers complained because the Allied control of the seas prevented Germany from buying munitions of war in the United States; and said that since Germany could not buy, the United States ought not to sell similar goods to the Allies. But President Wilson insisted, and international law upheld him, that citizens of neutral countries have a right to sell munitions to either belligerent, subject, however, to the right of the other belligerent to stop and seize them on the way. Germany's lack of sea power gave the Allies a great advantage on the seas, but it was not the duty, or the right, of the United States to redress this.

In retaliation for the pressure imposed upon them by the Allies, the Germans utilized a new weapon in the form of the submarine (*see* Submarine). In February 1915, they declared their intention to sink merchant vessels when found in British waters, without giving warning in advance. There was serious disagreement even in Germany as to the wisdom of

submarine warfare, but it was adopted as a method of driving the Allies to sue for peace. This plan was contrary to existing international law, which forbade attack on a merchant ship unless it resisted lawful search, and protected civilian passengers and crew as noncombatants whose lives should not be recklessly endangered. The German defense was that unrestricted submarine warfare was the submarine's only way of dealing with armed merchant ships. After the sinking of the *Lusitania*, May 7, 1915, Germany for a time refrained from similar attacks. But on Feb. 1, 1917, she announced the withdrawal of all pledges, and declared that she would sink on sight all merchant vessels, enemy or neutral, found near the British coast. President Wilson dismissed the German ambassador, Count von Bernstorff, and recalled the ambassador to Germany, two days later.

The Campaign for Preparedness

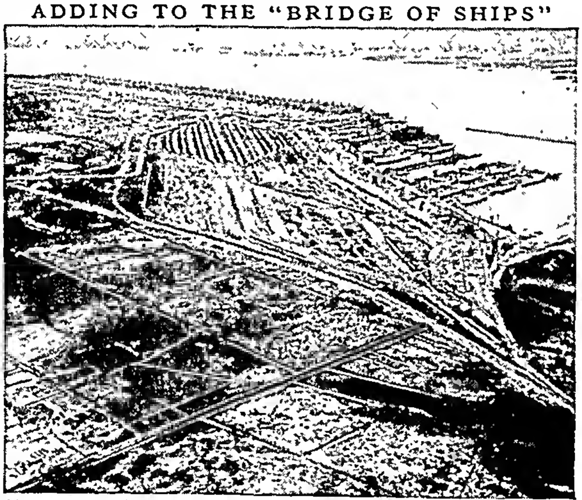
American opinion, at first neutral, came to believe Germany in the wrong, and then to believe that democratic government would be unsafe if Germany won. The drift into war against the Central Powers became stronger. President Wilson and Congress saw this, and made preparations along two lines: to urge upon the countries at war a peace that would be just, and to increase the military and naval strength of the United States. (*See* Wilson, Woodrow.)

The preparedness movement, which called for army and navy increases, began with the outbreak of the war in Europe, but President Wilson did not encourage it so long as he believed the neutral rights of the United States could be protected without force. Ex-President Theodore Roosevelt was in the forefront of preparedness advocates. After the sinking of the *Lusitania*, the President took the lead in the movement. Congress in 1916 passed the National Defense Act, enlarging the army and providing for officer training. Later in the year it passed the greatest appropriation bill thus far enacted for building battle cruisers, battleships, destroyers, cruisers, and submarines, so that by 1920 the United States might possess a navy second to none. Thereafter, the United States would not be forced to submit to any belligerent's interpretation of international law. The United States Shipping Board was created in 1916, to build and operate merchant ships, to take the place of foreign ships drawn out of transoceanic service.

In August 1916, Congress created a Council of National Defense, to be composed of the secretaries of war, navy, interior, agriculture, commerce, and labor, assisted by an advisory commission of seven civilians. Walter S. Gifford was director of the council; Samuel Gompers and Julius Rosenwald were among the civilian advisers. The council was to prepare for mobilization of the civilian population, and for "the coördination of industries and resources for the national security and defense." At the same time the production and distribution of food and fuel were placed under national administrators, Herbert C. Hoover and Harry A. Garfield, with almost dictatorial powers; and the railroads were placed under a federal director-general, William G. McAdoo.

While the preparedness measures were being enacted, President Wilson strove to lead the countries to peace. He had offered to mediate early in the war, but apparently all the powers were confident of winning and declined his services. Through his special agent and friend, Col. E. M. House, he kept in touch with the rulers of the chief belligerents. Most victories in 1915 and 1916 were German victories; and just before Christmas 1916, Germany urged her enemies to negotiate a peace. At the same time President Wilson invited all of the belligerents to state the lowest terms they would accept. When he received their replies, he made a famous speech to Congress, urging the countries to a "peace without victory"; because any other kind of peace would sow grievances and prepare the way for other wars. He had already in 1916 said that after the war there ought to be a league to enforce peace, to prevent any country from trying to conquer its neighbors, and to settle honest disputes by arbitration. And if such a league should be constructed, after a just and moderate peace, he promised to urge the United States to join it.

ADDING TO THE "BRIDGE OF SHIPS"



Here is an airplane view of the Hog Island shipyard, created by the United States to help replace shipping destroyed by German submarines. Yet huge as it was, this plant was only one small item in the effort America made to win the war.

A "World Safe for Democracy"

There was no favorable response to President Wilson's move for peace. Instead, after her peace proposals failed, Germany resumed unrestricted submarine warfare, and the United States was forced to enter the war. For Americans of German or Austrian descent it was a tragic situation, but most of these took their stand with the great bulk of Americans.

President Wilson was inaugurated for his second term March 4, 1917. He called Congress to meet in special session, and on April 2 he read to it his message stating that war had already begun by the acts of Germany. The stated aim of the United States in entering the war was to make a "world safe for democ-

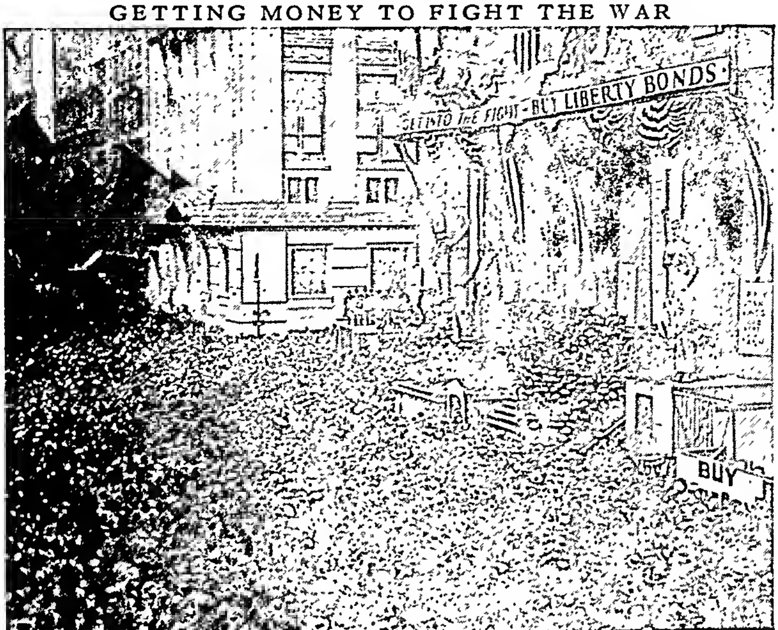
racy." There was no quarrel, he said, with the German people, who had contributed millions of good citizens to the United States; but he believed their government to have caused the war and to have fought it in violation of international law and the dictates of humanity. There could be no truce with it until it was placed in such a condition that it could not again endanger the peace of the world. Congress supported him, with few opposing votes, declaring war on April 6, 1917, and proceeding at once to pass the laws needed to bring the whole military strength of the United States into action.

"Work or Fight"

It took more than fighting men to uphold a nation in a World War. It required its wealth, and the time and service of those who remained at home. In the 18 months after the declaration, the country was placed upon a complete war basis. Public opinion frowned upon non-essentials. It was "work or fight."

This unanimity of public opinion was due in no small measure to skilful use of all the arts of advertising and publicity as well as modern facilities such as newspaper and motion pictures (radio broadcasting was not then known). A Committee on Public Information issued newspaper articles, posters, and other material, explaining the issues of the war, urging economies in food, fuels, and other materials, and inspiring everyone to utmost effort. A nation-wide organization of so-called "four-minute speakers" gave talks at theaters, before clubs, and on all other possible occasions, until everyone understood, and was coöperating with, the national program.

GETTING MONEY TO FIGHT THE WAR



Here, before the statue of George Washington on the steps of the United States Subtreasury at Broad and Wall streets, New York City, a seething crowd is being told why it must buy Liberty bonds. Similar scenes the country over, with house-to-house canvasses, raised over 21 billion dollars in five great "drives."

Organizing the Army

No one knew exactly how many men there were of proper age, and capable of bearing arms. But on May 18, 1917, the Selective Service Act called for the registration on June 5 of all men between the ages of 21 and 31. Of these, 10,679,814 signed up at once; and when in 1918 the age limits were extended to include 18 and 45, there were 13,228,762 more registrations. Not all of these were wanted in the armies. Many were needed in industry. Many were physically unfit, or had too many dependent upon them to go. But nearly 4,800,000 men were taken into military service. Of the 93 combat divisions which were organized, 42 in all reached France, and 30 saw service in the line. The numbers below 26 were assigned to divisions made up chiefly from the regular army. The numbers 26 to 42 were assigned to National Guard divisions. Numbers above 75 were given to the national army, as the draft units were called, but after the summer of 1918 the term national army included all forces.

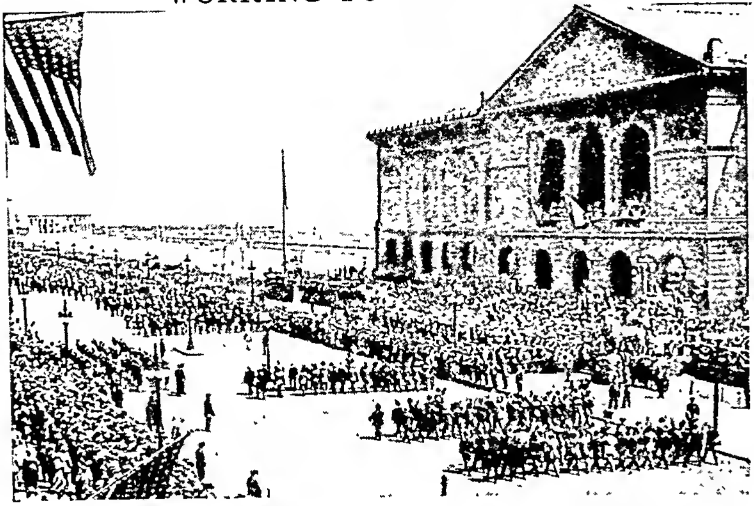
There were needed about 200,000 commissioned officers to drill and lead the troops. About half of these were trained hurriedly in officers' training camps; over 40,000 physicians and surgeons and dentists received commissions, and most of the remaining officers came from the ranks of the regular army or from the National Guard. Political appointments to high command, such as had prevailed in the Civil War, did not occur. Even ex-President Theodore Roosevelt, highly distinguished, but not a professionally trained soldier, and past effective military age, was denied command.

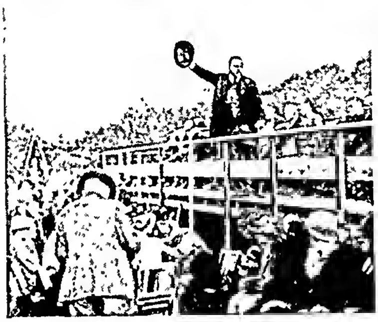
Difficulties and Troubles

The roster of names in many a battalion sounded like a directory of Europe; but regardless of his father's nationality the American soldier proved to be an American. These millions, from every walk of life, were concentrated in training camps. There were tent camps to be built in the South, and permanent cantonments wherever needed. To build the camps in a hurry taxed the resources of the building trades and of the railroads.

The men required clothing, food, and weapons, as well as proper medical attention in camp and overseas. To procure these the Council of National Defense was summoned for advice, and set up in the summer of 1917 a War Industries Board that watched the contracts and tried to regulate the flow of all the materials and commodities that were called for. There was much confusion, for nearly everyone was engaged on a job that he had never filled before. There was special difficulty when the needs were for elaborate machines that had to be designed and made in factories that did not yet exist. Airplanes caused much trouble. Artillery was slow. Gas, and the equipment for its use, could not be hurried.

WORKING TO BUILD AN UNSHAKABLE "WILL TO WIN"





From the outset of war, an unremitting, powerful effort was made to maintain unceasing work for victory. Impressive parades sent drafted men to training, as in Chicago (upper left). Noted speakers like ex-President Theodore Roosevelt (lower left) addressed meetings. Posters by noted artists, like those shown, for the Victory Liberty Loan and the Red Cross, appeared everywhere. The last picture shows Secretary of War Baker drawing a number to decide the order of service for drafted men.

By Christmas, when volume production was beginning to get under way, the railroads had more business than they could handle, the port equipment was scanty, and the weather was the worst in many years. Excessive cold held up traffic and raised a question whether there would be coal enough. The Fuel Administration stimulated production of coal and restricted its use. In January 1918, there were "coal-less days," on which ordinary factories closed down to save fuel. The Food Administration had been at work since the summer of 1917, urging greater production of food, and teaching the population that remained at home to go without sugar, wheat flour, meat, and fats, in order that these foods might be shipped abroad.

Obtaining Ships and Money

But there was a scarcity of ships in which to send men, munitions, and food, for the German submarines had destroyed a large number of the Allied merchant ships. The United States Shipping Board began to order ships in great numbers. Experiments were being made in feverish haste with steel, wood, and even reinforced concrete ships. Best results came from standard type "fabricated" steel ships, most of whose parts could be made at ordinary steel plants and then assembled at the shipyard. At Hog Island, in the Delaware River flats below Philadelphia, over $60,000,000 was spent in building the world's greatest shipyard; 50 shipways were built in a single row.

The war called for money almost without limit, not only to pay the expenses of the armies of the United States, but to assist the Allies who were drained after three long years of war. Almost at once the Treasury began to lend money to the associates of the United States in the war, and nearly $10,000,000,000 went this way before the war was over. There had to be loans for home needs. Four "Liberty Loans" were arranged to sell United States bonds, and there was a fifth, a "Victory Loan," after the fighting ceased. By means of these, more than $21,000,000,000 was advanced to the United States government. Taxes were increased, using heavily the new income tax, in an effort to pay as large a portion of the war cost out of current taxes as possible. About one-third was

raised this way, making the war more nearly a "pay as you go war," than is usually the case.

An American Front in France

Because of the prodigious preparations needed, the first World War ran on a full year after the entry of the United States before American aid was visible in France. The Allies, wearied, were just holding on, waiting for help. They could not be beaten, but they could not win.

The navy was first to help in a direct way. Admiral William S. Sims was sent to London in the spring of 1917, and was followed by a fleet of destroyers that went to work at once. It was a thankless and dangerous job, holding the blockade, chasing submarines, and convoying merchant ships. Several of the United States battleships joined the British fleet. Probably the greatest service rendered by the navy was in laying a barrage of contact mines across the English Channel, and also closing the northern outlet of the North Sea from the Orkney Islands to the coast of Norway, 230 miles. Before the end of the summer of 1918, more than 50,000 mines were laid. (*See* Torpedoes and Mines.) The submarine was bottled up, and no large American troop transport was destroyed by submarine attack.

For the command of the American army in France Gen. John J. Pershing was selected. The first combatant unit of American troops had reached France on June 27, 1917, and a few days later General Pershing arrived in Paris. "You have come, God bless you!" said Marshal Joffre to Pershing as he stepped from the train. On July 4, American troops marched through the streets of Paris amid scenes of indescribable joy on the part of the people. That same day General Pershing laid a wreath of roses on the tomb of Lafayette, and was reported to have uttered these simple but eloquent words: "Lafayette, we are here" (*Lafayette, nous voilà*). The sentiment was certainly that of General Pershing's address, but the words quoted so widely were actually spoken by one of his staff officers, Lieut.-Col. Charles E. Stanton.

However, much remained to be done before the Americans could lend powerful aid. The British and French believed that neither General Pershing nor other American higher officers had the knowledge and experience necessary to control large-scale troop operations in the type of fighting then being done; so they wanted to incorporate American troops by battalions and regiments in their own divisions. General Pershing insisted upon forming an American army, and set about the colossal task of providing for it. Since the British would hold the northern line near the Channel ports and the French would cover Paris, he planned to take the sector south of Verdun, and to use the ports of Brest, Saint-Nazaire, and Bordeaux on the Atlantic coast and Marseilles on the Mediterranean for his supplies. This meant building or improving railroads from the ports to the sector (for all French main-line railroads centered in Paris), and erecting barracks, hospitals, supply depots, construction and repair shops, and schools and training areas for all the different arms of service. His own headquarters were established at Chaumont.

First Appearance at the Front

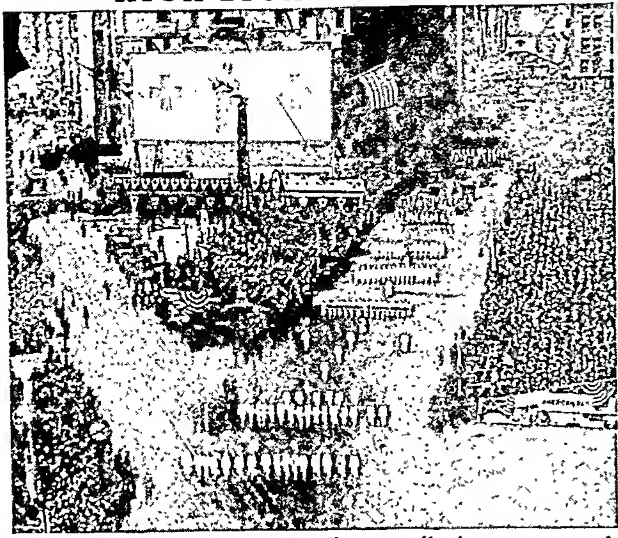
Soon the French ports were bustling with men creating these facilities, and ships unloading troops—a small trickle of these at first, then more and more as facilities increased and ships were found. The troops vanished into their training areas, where grueling weeks or months were spent perfecting their training; and as each division was judged ready, it was given a tour of duty in a quiet sector, to learn trench life and become accustomed to the presence of an enemy. Then the division was judged ready for hard fighting. The first American division to enter the line under this arrangement was the 1st, which took over a quiet sector in Lorraine, firing its first shot Oct. 23, 1917.

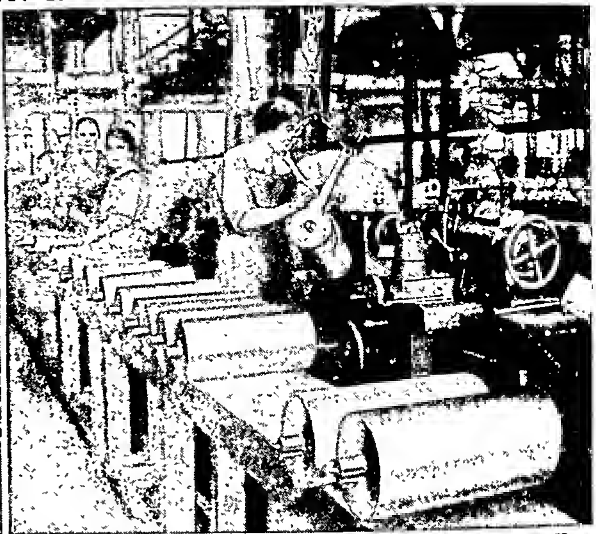
In all, some 20,000 freight cars and 1,500 locomotives were shipped in sections to France and assembled there by railway engineers. Every combat division,

TEACHING THE NATION THAT "SAVING MEANT VICTORY"

Food saving, perhaps, was stressed most throughout the nation, as evidenced by the Washington, D. C., community demonstration of cooking without waste. At the left is a poster urging saving of coal, and at the right humble "junk" is the theme.

HIGH LIGHTS ON HOW WOMEN HELPED TO WIN THE WAR





Here we see only two of the countless contributions women made to victory: an impressive parade crossing Madison Square, New York City, May 18, 1918, during a Red Cross drive, and (right) some of the thousands who went into munition making.

about 30,000 men—and by the Armistice, some 40 divisions were in France—required 25 carloads of supplies for its daily consumption. All of this vast enterprise, of providing food and equipment, was performed by the Services of Supply ("SOS"). The chief purchasing agent was Gen. Charles G. Dawes, and after July 29, 1918, the commanding general of the SOS was Gen. James G. Harbord.

The Work of the A.E.F.

Soon after his arrival, Pershing reported to the War Department that fewer than 1,000,000 men could not make an army, and that his plans required 4,000,000 men as soon as they could be shipped. The American Expeditionary Forces (A.E.F.) beginning to gather slowly in France in June 1917, reached about 300,000 men, when on March 21, 1918, the German armies plunged into the battle of the Somme. The Americans came, in theory, by divisions of about 30,000 fighting men; but in fact they came as ships could be found to move them, some fully equipped, some who had not even been taught to load their rifles. For a year after the United States entered, England, who owned the ships, was slow to lend them for this purpose. Only parts of four divisions had been in the line on March 21, 1918—the 1st, 2d, 26th, and 42d. These were offered to be used as needed when the line wavered during the first week of the German drive on the Somme. The ominous danger of German success did two things: it induced England to consent to the appointment of Foch as commander-in-chief of the Allied armies, and it induced her to provide the ships to ferry the A.E.F. to France. Through the five months after April 1918, nearly 10,000 American troops a day were sent to France, and Pershing's force became a reality.

The temper of the A.E.F. was tested in the early summer. There had been raids upon American trenches, one of them a formidable mass attack upon the 26th division at Seicheprey in April; but no deliberate demonstration of the power of a division of the A.E.F. was made until at Cantigny, May 28, the 1st Division took its objective and held it firmly against counter attacks. The battle of the Marne was already under way, and the next day the 2d and 3d divisions were hurrying towards Château-Thierry to help fill the gap caused when the French armies broke before the German advance. In the next two weeks the name of Belleau Wood was heard, where the Marine Brigade and the army regiments of the 2d Division did valiant service June 1–26. After this there were no doubts about the ability or willingness of the A.E.F. to fight.

Finally in August, General Pershing and the Allied commanders agreed on a plan of campaign in which the American First Army was to be used as a unit in a major offensive. As a preliminary operation the Americans were to aim at the reduction of the famous Saint-Mihiel salient, north of Toul, which the Germans had maintained doggedly ever since their first drive in 1914. The morning of September 12, after a four-hour barrage, in which the Americans were supported by heavy French artillery and colonial troops, the attack began at 5:00 a.m., and the salient was "pinched out" by morning of the 13th. Nearly 3,000 pieces of artillery and 1,500 airplanes gave the Americans overpowering superiority. The operation fully proved the usefulness of the First Army.

The elimination of the Saint-Mihiel salient was the prelude to the much greater battle to begin September 26, between the Meuse River and the Argonne Forest.

The battle of the Meuse-Argonne, which was "America's greatest battle," continued from September 26 until November 11, and used 29 combat divisions in its 47 days of action. It was part of a general engagement that pressed on the German line from Verdun to the English Channel (*see* Meuse-

Argonne). About 1,200,000 Americans participated; and when their drive ended, the war was over.

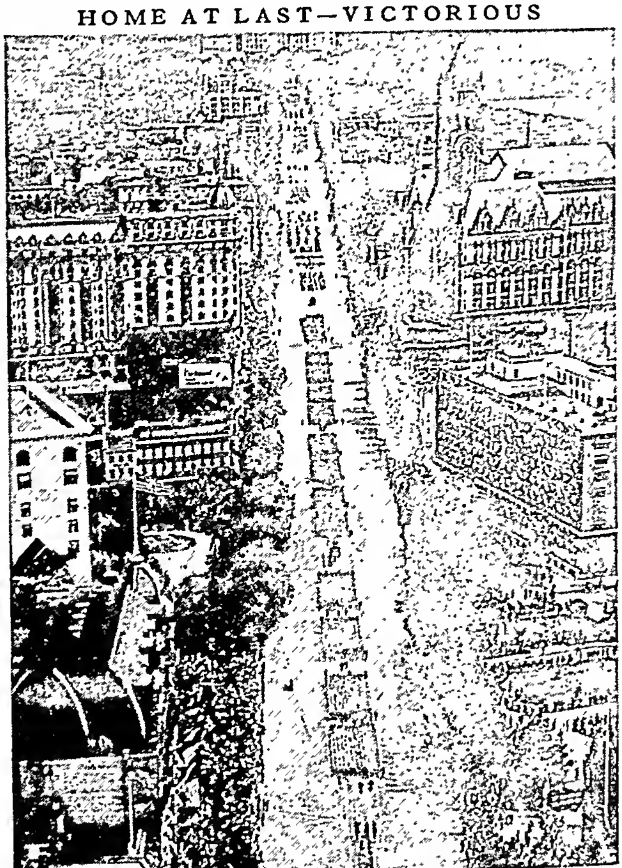
The cost of this American effort will never be entirely known. Americans killed in battle, dead of wounds, or declared dead numbered 53,407; illness and other causes brought the total deaths to about 126,000; 204,002 were wounded (not fatal). On June 30, 1919, the government had spent about $27,729,000,000 directly for the war and had lent its Allies more than $9,455,000,000. Loans and expenditures growing out of the war were to continue for years. The indirect losses are beyond computation.

The Peace and Its Results

THE PEACE Congress which was to end the greatest war the world had seen met in Paris, January 1919. There were representatives from all the countries which had been at war with the Central Powers. The important questions were settled first by the leaders of the five greatest powers—President Wilson, Premier Lloyd George of Great Britain, Premier Clemenceau of France, Premier Orlando of Italy, and (when Japanese interests were involved) Baron Makino of Japan.

One of the first tasks to which the delegates turned was drawing up a constitution for a League of Nations designed to reduce or abolish the likelihood of future wars. This "Covenant of the League of Nations" was made the first part of the Treaty of Versailles, which ended the war between Germany and the Allied Powers (*see* League of Nations). Other chief provisions were:

HOME AT LAST—VICTORIOUS



Like the victorious Grand Army of "Boys in Blue" of 1865, the 1st Division paraded Pennsylvania Avenue in Washington on its return home. This view was taken from the Treasury Building and looks toward the Capitol in the distance.

1. By the territorial terms of the treaty, Germany returned Alsace and Lorraine to France. The rich coal mines of the Saar basin were ceded to France for 15 years, under control of an international commission. Belgium was awarded the German frontier districts of Malmedy, Eupen, and Moresnet. Much of Posen and west Prussia were given to the new republic of Poland. The free city of Danzig was put under control of the League of Nations, and Memel with the surrounding territory was turned over to the Allied Powers. (Memel was given to Lithuania in 1924.) Germany also lost all her colonies, control passing to various Allied nations under mandates from the League of Nations. Part of the Cameroons, Togoland, part of German East Africa, and Nauru Island in the Pacific went to Great Britain. France shared in the division of the Cameroons and Togoland. The Union of South Africa took over Germany's possessions in Southwest Africa, and Belgium assumed control over part of German East Africa. Japan was given a mandate over Germany's Marshall, Caroline, and Marianas Islands (except Guam). Australia assumed the same control over northeast New Guinea and adjacent islands. New Zealand took over German Samoa. Germany also ceded its rights in Shantung, China, to Japan.

2. Military clauses of the treaty were designed to make it impossible for Germany to attempt another offensive war. Her army was limited to 100,000 men; the manufacture of munitions was restricted to the needs of such a force; conscription was abolished; the fleet was restricted to a mere coast defense, with only six battleships, six light cruisers, and a few destroyers and torpedo boats. Germany was forbidden to have submarines or an air force, military or naval, and all her naval defenses within 50 miles of the coast were ordered destroyed.

3. The section of the treaty covering reparations demanded that Germany accept full responsibility for the war, and make reparations in cash and in goods for the damage she had caused. The amount was to be determined later by a special commission. The sinking by the German commander in June 1919 of most of the fleet which had been surrendered to the British at Scapa Flow in 1918, added considerably to the damages. Merchant vessels were to be given to the Allies to replace their vessels destroyed by submarines.

4. The treaty stipulated certain guarantees to assure that Germany would meet all her obligations. Chief of these was the provision that for 15 years the Allies should occupy bridgeheads east of the Rhine and German territory west of the Rhine. The mandates over former German colonies were part of the guarantees.

When the treaty was finally completed, the Germans were notified to send delegates to Paris to receive it. In the same hall at Versailles where the Germans had humiliated the French by proclaiming the German Empire in 1871, the treaty was handed to the head of the German delegation, May 7, 1919. The German delegates made most strenuous objections to the rigorous terms, pointing out their inconsistency with President Wilson's "Fourteen Points," which they claimed had been mutually accepted at the time of the Armistice. But the Allies made only slight concessions. "There must be justice," they declared, "for those millions whose homes and lands and property German savagery has spoliated and destroyed." Finally on June 28, 1919, exactly five years after the Austrian royal heir had been murdered, the German delegates affixed their signatures to the treaty.

Treaties with Austria and the Smaller Powers

In the meantime a treaty with Austria was arranged and was handed to the Austrian delegation, June 2, 1919. The head of the Austrian delegation, on receiving the treaty, addressed the Peace Conference in French instead of German, and declared that the new Austrian republic was free "from the horrible crime" of starting the war of 1914. He hoped thus to induce the Allies to modify the terms. The Allies made a few concessions, but in the main the Austrians suffered a severe punishment for their part in the war. The provisions of the treaty reduced Austria to a small country with six million people. It required her to recognize the complete independence of Bohemia, Hungary, and the Southern Slavs; to cede large districts including most of her coast line to Italy, with a good part of Hungary to Rumania; and to make reparation for damage done. The Austrians signed their peace treaty at Saint-Germain, Sept. 10, 1919.

Later treaties fixed the new boundaries of Turkey and Bulgaria. Bulgaria did not suffer greatly in loss of territory (Treaty of Neuilly, Nov. 27, 1919), but much of the former Turkish Empire, including Palestine, Mesopotamia (Iraq), and part of Syria, was turned over to the Allies, to be administered by them as "mandataries" of the League of Nations (Treaty of Sèvres, Aug. 10, 1920). Smyrna was put under the administration of Greece.

The United States Rejects the League

Various disputes protracted the exchange of ratifications, so that it was not until Jan. 10, 1920, that the German treaty was declared in force. Even then China and the United States were not included among those nations making peace with Germany. China objected to the cession to Japan of the rights previously held by the Germans in the Chinese province of Shantung. In the United States, because of a dispute which broke out between the majority in the Senate and President Wilson, the Senate rejected the act ratifying the treaty Nov. 19, 1919 and March 19, 1920 (*see* Wilson, Woodrow). The chief point in dispute involved the question of reservations to be made concerning the entrance of the United States into the League of Nations. The question was threshed out before the people of the United States in the presidential election during the autumn of 1920, and resulted in the election of the Republican candidate, Warren G. Harding, as president, with an overwhelming majority of Republicans in Congress. During the special session of Congress, called soon after, a resolution was passed by Congress and signed by the President (July 2. 1921) declaring the state of war between the United States and Germany and Austria-Hungary to be at an end. The United States then concluded treaties of peace with Austria and Germany, which were signed August 24 at Vienna and August 25 at Berlin.

Little Wars After the Big One

Throughout the period consumed by these lengthy negotiations, little wars, caused by impatience with the slowness of the diplomats, or dissatisfaction with impending results, were disturbing the general peace. Italy insisted on having the entire eastern coast line of the Adriatic Sea, including the port of Fiume, which was also claimed by Yugoslavia, a new country formed by the union of Serbia and Montenegro with the Slavic people of the southern and western parts of the former Austro-Hungarian monarchy. For a time an Italian filibustering expedition led by the poet-aviator D'Annunzio held the city and threatened a new war; but later (Nov. 12, 1920) the two countries agreed to make Fiume an independent city, and Yugoslavia obtained some of the disputed region. A later treaty (Jan. 24, 1924) gave Fiume to Italy.

The most serious upset to Allied plans came from Turkey, rehabilitated under the dictatorship of Mustapha Kemal (*see* Turkey). Greece, hoping to secure and enlarge her gains, started war in Asia Minor. The Turks crushed the Greek forces, and the Allies, finding Turkey too strong to handle, consented to replace the Treaty of Sèvres with one drawn at Lausanne (July 24, 1923) by which Greece lost all claims in Eastern Thrace and Asia Minor (*see* Greece).

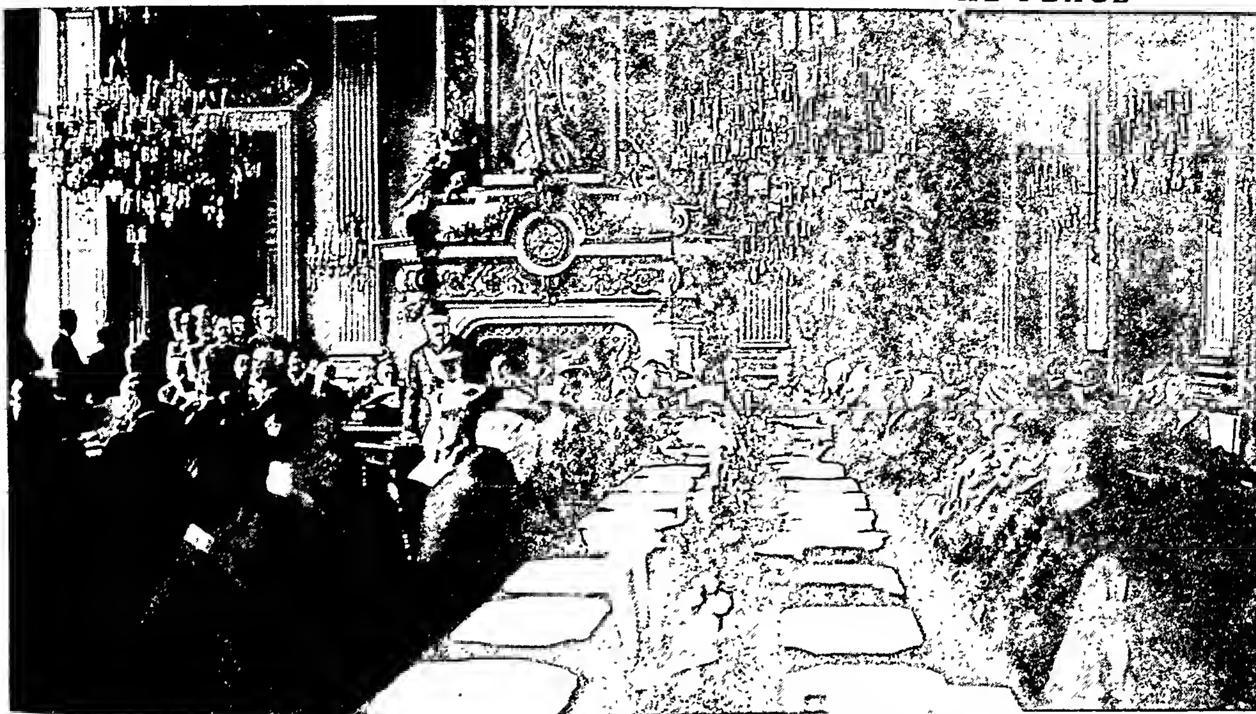
Meanwhile, Arab outbreaks had presented continuous difficulty for the French in Syria, culminating, in October 1925, in the French bombardment of Damascus (*see* Syria). The Poles occupied Upper Silesia in defiance of the peace treaty and a plebiscite favoring return to Germany. October 12, 1921, the League of Nations awarded Poland the best part of the region in dispute.

"White" Assaults on "Red" Russia

The bitterest and most protracted fighting, however, centered about Russia. In 1917, fearing the Bolsheviki and possible German use of Archangel, the Allies stationed some 15,000 British and Americans in that district, and had a force including 8,000 Americans in Siberia. Admiral Kolchak, an anti-Red, or "White," leader in Siberia, with the aid of the Czechoslovak Legion (Czech deserters from the Austrian armies who had fought with Russia), established an "all-Russian" government at Omsk, Nov. 18, 1918.

Two other "White" movements were led by General Denikin in southern Russia, and General

OPENING OF THE CONFERENCE TO PREPARE THE PEACE



Here delegates from all the Allied and Associated Powers are gathered in the great historic Clock Room of the Quai d'Orsay, listening to an interpreter translate the opening address given by President Poincaré of France. President Wilson is near the far wall, immediately to the left of the interpreter, as you view the picture. Such "plenary sessions," with all delegates present, were few, the real work being done in committees.

Yudenich in Esthonia. For a few weeks, in the summer of 1919, it seemed as if the Bolshevist armies, attacked on all sides, might fail. Then Yudenich was badly defeated within ten miles of Leningrad and Denikin was repulsed when he was almost within striking distance of Moscow. Kolchak lost Omsk, resigned his command, and was betrayed to the Bolshevists, who executed him Feb. 7, 1920. The Allied governments thenceforth abandoned their policy of "intervention" in Russia, although late in 1920 Allied ships rescued Baron Wrangel, who had succeeded Denikin in command in the Crimea, and transported the remnants of his army to Constantinople.

In addition to these troubles Bolshevist Russia was at war with Poland, which had been encouraged by a loan of $50,000,000 from the United States, and by shipments of French war supplies. In the spring and summer of 1920 the Poles were steadily driven back until their lines were in the outskirts of Warsaw. At this stage the Polish army was placed under General Weygand, Foch's chief of staff. By brilliant tactics he completely reversed the tide and within 60 days had cleared Polish soil of the Russian forces. The peace treaty, signed March 18, 1921, gave Poland a large slice of Russian territory, plus an indemnity of 30,000,000 gold rubles (about $15,450,000).

Problems of Industry and Finance

These military episodes were far overshadowed in importance, however, by the difficulty of reëstablishing commerce, industry, and particularly finance, on a normal peace basis. Roughly, the problem fell into three parts: restoring prosperity and normal finance within each country; obtaining reparations payments from the defeated countries; and settling interallied debts. The latter as a practical matter meant payments to the United States by the nations of Europe, since the United States was the ultimate creditor.

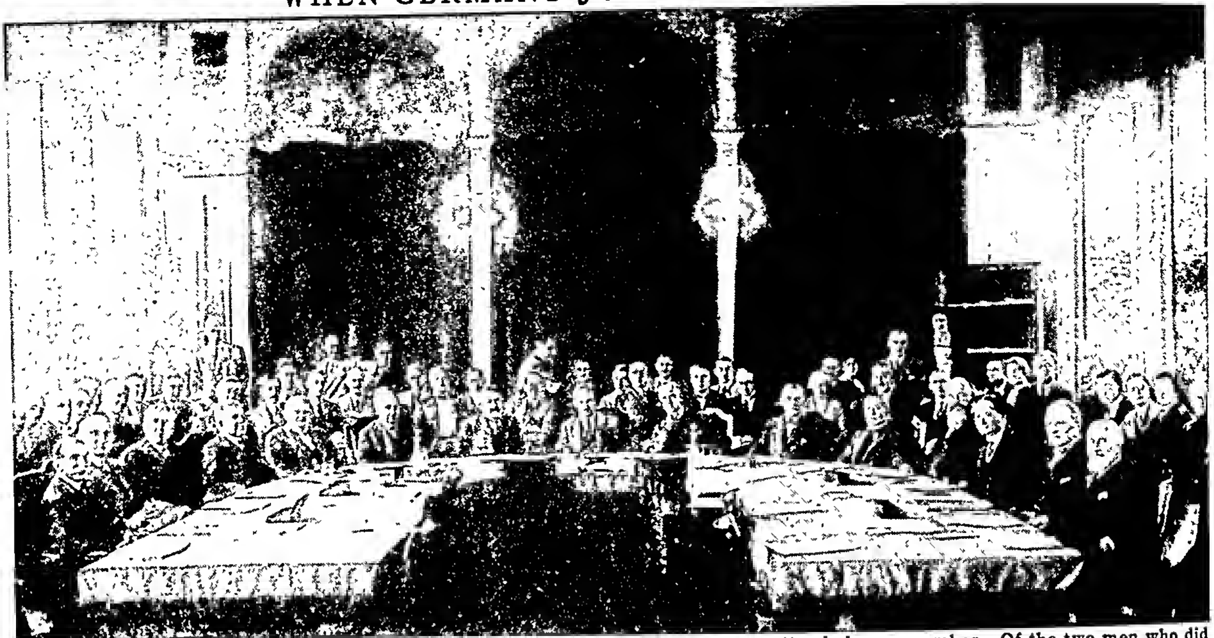
The first task relating to reparations was settling the amount, which was left open by the Treaty of Versailles. On July 16, 1920, at Spa, six of the countries entitled to reparations payments from Germany agreed among themselves upon their percentage shares of these payments. France was to receive 52 per cent, the British Empire 22 per cent, Italy 10 per cent, Belgium 8 per cent, Japan and Portugal $1\frac{1}{2}$ per cent; the rest was for Yugoslavia, Greece, and Rumania. Later these proportions were slightly changed.

Fixing the Reparations Payments

Next came the fixing of the total amount of German reparations payments. On April 27, 1921, this amount was fixed by the Reparation Commission at 132 billion gold marks, or about $31\frac{1}{2}$ billion dollars. Even at that time, many students of the situation felt that Germany would never be able to pay such a sum.

Near the end of 1922 Germany fell behind in her reparations deliveries of coal, either through inability or unwillingness to keep up to schedule. On December 26 she was judged in default by the Reparation Commission. In January 1923 France and Belgium occupied the Ruhr coal and iron district on the right bank of the Rhine, under authority of the Treaty of Versailles. both to enforce payment by Germany and to seize property in satisfaction of reparation obligations. This was the most highly industrialized area in

WHEN GERMANY JOINED THE LEAGUE



This is the first meeting of the Council of the League of Nations which Germany attended as a member. Of the two men who did most to bring this about, Gustav Stresemann of Germany is fifth from the left at the horseshoe table, and Aristide Briand of France is near the center, in line with the left-hand pillar in the background, as you view the picture.

Germany and its seizure totally demoralized the economic life of the nation. Immediately all reparations payments ceased, for Germany denied the justice of the French action, and the situation took the form of a stalemate. The paper mark became utterly worthless, and a large section of the German public was financially ruined. The occupation was highly unpopular in Great Britain and marked a widening of the breach between France and England in their foreign policies. Great Britain favored a policy of friendship with Germany and was eager to have reparations fixed at a definite and reasonable sum. The United States and Italy took a similar attitude. Belgium backed France.

The Dawes and Young Plans

Towards the close of 1923 the Reparation Commission, acting upon British and American suggestions, created two committees of experts, one to reëxamine the ability of Germany to pay and to make suggestions for the balancing of the German budget and stabilizing of the currency; the other to investigate the question of capital exported from Germany to avoid reparations payments. The first and principal committee was headed by an American, Gen. Charles G. Dawes, and the report submitted came to be known as the "Dawes Plan." The plan was accepted by the Reparation Commission and by Germany, and went into force on Sept. 1, 1924. French and Belgian troops then evacuated the Ruhr.

The Dawes Plan provided for payment of a billion gold marks the first year, increasing after four years to an annual payment of $2\frac{1}{2}$ billion marks. A new Reichsbank and a new German currency were established. The annual payments were secured by certain tax revenues and liens against German railways and industrial establishments, and the whole system was placed under the supervision of an Agent General for Reparations Payments. This post was temporarily given to the American, Owen D. Young, and then to another American, Seymour Parker Gilbert.

At first German obligations under the Dawes Plan were met promptly. But by 1928 it became evident that further revision was necessary. Another expert committee, headed this time by Owen D. Young, worked out another report—known as the Young Plan—which went into effect on Sept. 1, 1929. The Young Plan called for 59 annuities of varying amounts, with a total present value reaching approximately 31 billion marks, or more than 7 billion dollars. All forms of coercion and control were removed, and the payment of reparations was to be made through a new international bank called the Bank for International Settlements. The annual payments under the Young Plan were made a definite and fixed obligation of Germany, but Germany was granted the right, under specified conditions, to postpone two-thirds of each annuity for a period of not longer than two years.

The Interallied Debts

At the close of the war, the principal lending countries were the United States and Great Britain. It was evident, however, that in most cases the sums due were beyond the ability of the debtor countries to repay; so in the act of Feb. 9, 1922, establishing the Debt Funding Commission, and later acts, the United States announced its willingness to fund the debts and spread the payment of principal and interest over long terms of years. The funded debts under this arrangement then stood as follows: Belgium,

$417,780,000; Czechoslovakia, $115,000,000; France, $4,025,000,000; Great Britain, $4,600,000,000; Italy, $2,042,000,000; others, $480,000,000.

Despite the Young Plan, in 1931 Germany had reached a point where it was impossible to meet reparations payments (*see* Germany). President Hoover then proposed that Germany's creditors grant Germany a moratorium or delay of one year on all payments due them. To make this possible he offered, subject to confirmation by Congress, a moratorium on all debts due the United States by these same powers. After some difficult negotiations with France this moratorium, with some modifications, was adopted. In July 1932 representatives of Germany and her creditor nations, meeting at Lausanne, virtually agreed to end further reparations payments, scaling down the 7-billion-dollar total of the Young Plan to the equivalent of $714,000,000.

Germany's Financial Plight

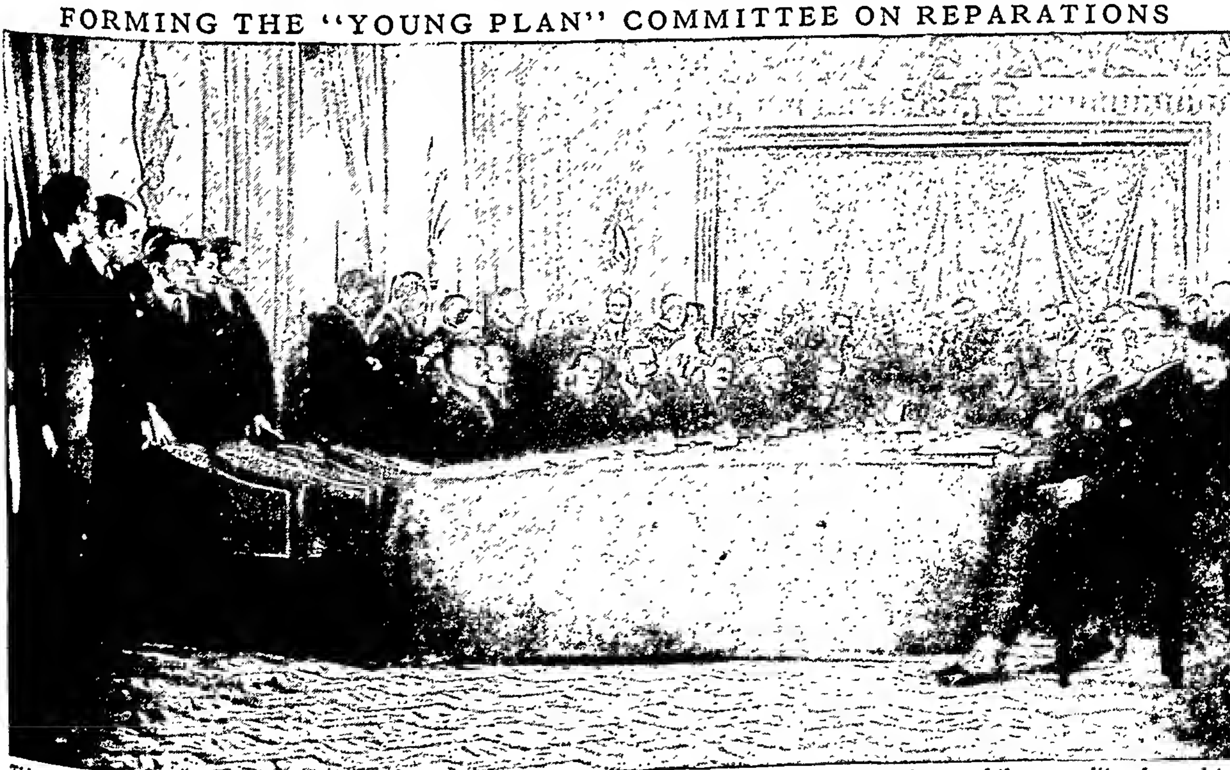
The continued and ever-increasing difficulty encountered by Germany in meeting her reparations obligations was produced by causes common in greater or less degree to the postwar economic situation in all the major belligerent countries. War expenditures, expenses of rebuilding lost or worn or damaged ships, factories, and railroads, expenses of new government services under the republic, all bore heavily upon German budgets, governmental and private. Billions of dollars were borrowed abroad (chiefly in the United States) by German governments, central and local, and by German business concerns, and interest charges mounted accordingly. Furthermore, Germany had lost markets overseas and in Europe, as a result of competition and tariff barriers, and was thus prevented from building up foreign credits with which to pay its debts.

This situation prevailed also, though to a lesser degree, in the rest of Europe. After Germany stopped making reparations payments in 1932, most European nations defaulted on their debts to the United States. One notable exception was Finland, which paid its instalments regularly. After the Russo-Finnish War of 1939–40, the United States rewarded this nation by granting it a ten-year moratorium.

International Relations

For a few years diplomatic relations among the nations of Europe seemed to run more smoothly. Russia gained trade agreements and, later, recognition and resumption of diplomatic relations with most of Europe and with the United States. For a time Germany's relations with the victorious powers also improved. Although there remained many sore spots on the map of Europe and many pressing problems were unsolved by the peace treaties, willingness to proceed in peace and friendship seemed to prevail during the years 1925–1930. Yet one feature of these years was the building up of a network of alliances which crisscrossed Europe and which were not in accord with the aims of the League of Nations or the international conferences. Thus France renewed alliances with Poland and the countries of the Little Entente (Czechoslovakia, Rumania, Yugoslavia) as protection against

FORMING THE "YOUNG PLAN" COMMITTEE ON REPARATIONS



This view shows the session of delegates which elected Owen D. Young of the United States chairman of the committee formed to fix the total amount of reparations due from the defeated countries to the victorious ones. This meeting was held in one of the hotels in Paris, in the elaborate surroundings which are a normal part of European diplomacy.

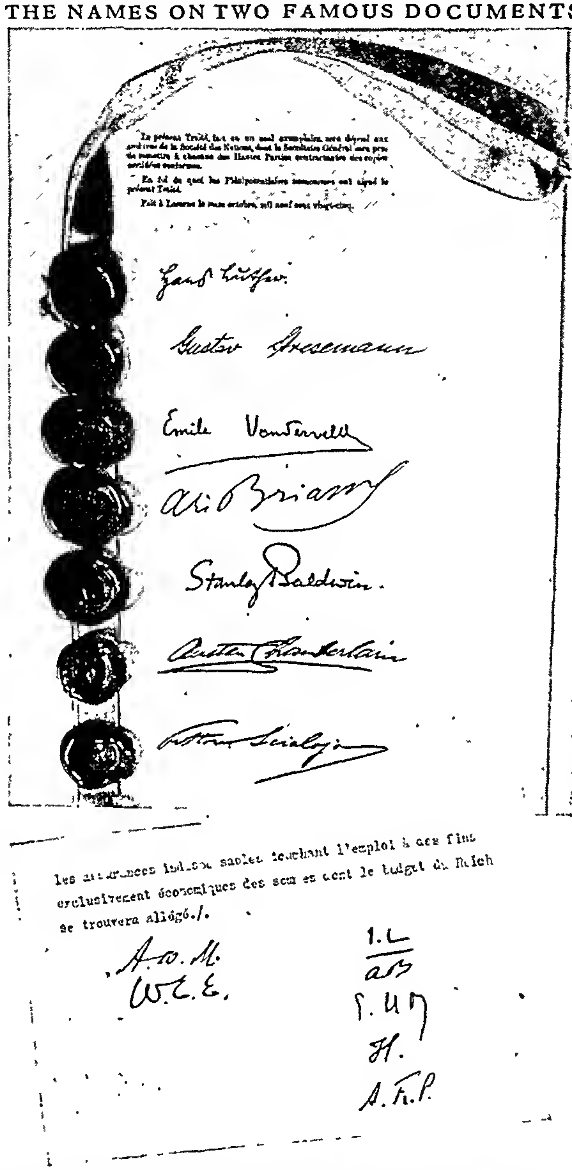
possible danger from Germany, Austria, Hungary, and Russia. League guarantees of territorial security were felt to be unreliable, and it was not until the Anglo-Italian guarantee of the mutual non-aggression pact concluded by France and Germany at Locarno in October 1925 that relief was felt in this direction. Even then, and even with the signing of the Briand-Kellogg Peace Pact Aug. 27, 1928, peace seemed insecure and disarmament still dangerous and far distant. Minority groups were protected to a considerable degree by the League against oppression at the hands of their new sovereigns (Germans in Poland and Hungarians in Rumania, for example). The occupied territories on the left bank of the Rhine were evacuated by the French, Belgians, and British in 1929–30, when the Young Plan regarding reparations went into effect, but cordiality and confidence were still lacking.

The War-Guilt Question

Two intimately related questions continued to vex the nations: war guilt and revision of the peace treaties. France and her allies in central Europe, Czechoslovakia, Rumania, Yugoslavia, and Poland, steadfastly opposed any change in the treaties. Germany, Austria, Hungary, and Bulgaria agitated for revision, especially of clauses which declared them responsible for starting the war.

Demands for revision of several territorial settlements were constant and bitter, centering upon the arrangements made for Upper Silesia, Danzig and the Polish Corridor, Transylvania, and the Tyrol. Germany urged its right to Upper Silesia, Danzig, and the Corridor; Hungary felt that Rumania had been given too much of Transylvania; and Austria bemoaned the Tyrolean Austrians lost to Italy. Italy generally befriended the "revisionists," but in 1931 backed France in preventing a proposed customs union between Germany and Austria.

THE NAMES ON TWO FAMOUS DOCUMENTS



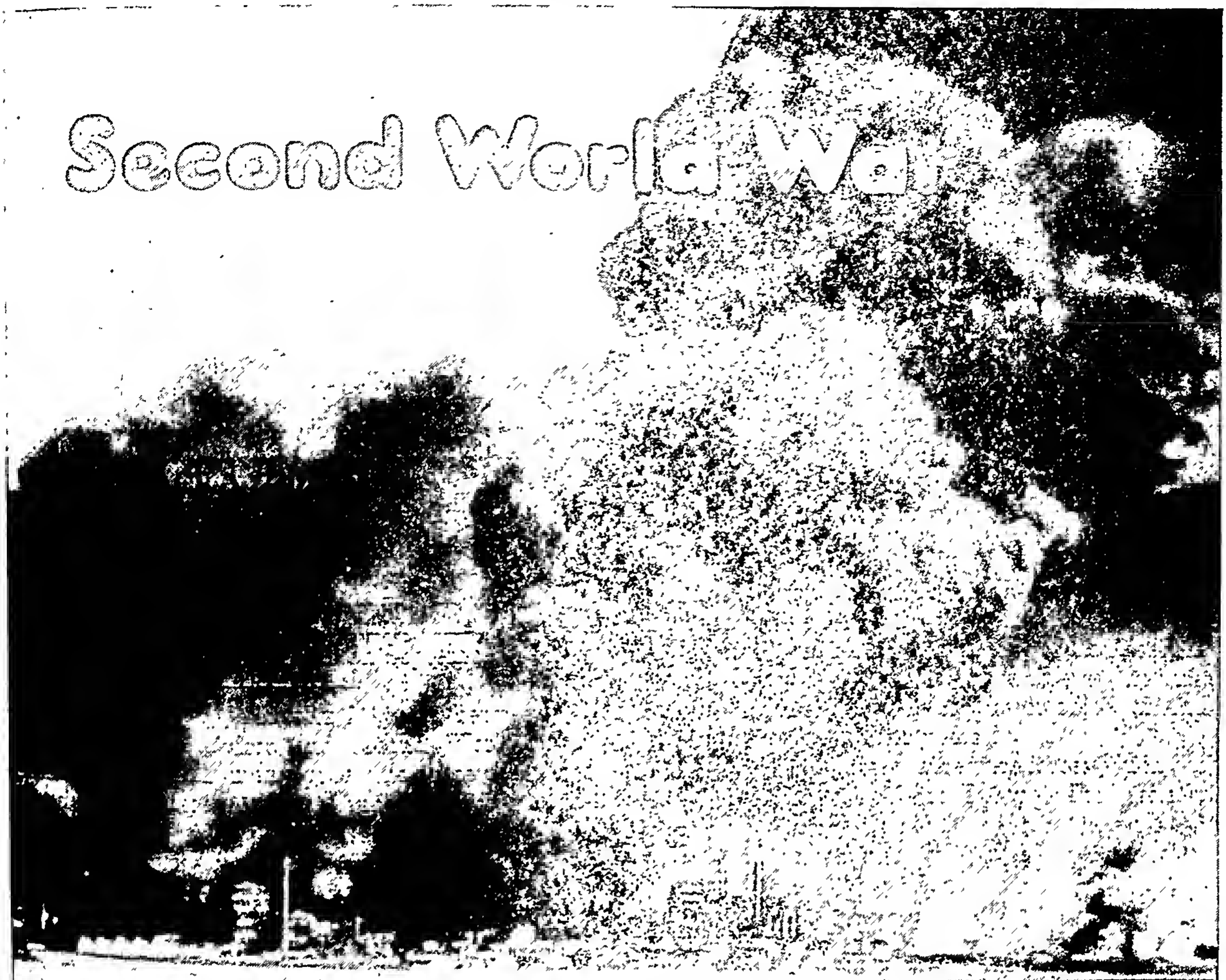
Above are the signatures to the formal Treaty of Locarno, complete with seals and ribbons. Below are the initials which gave effect to the Hoover moratorium, as between France and the United States. The men represented are Andrew Mellon, Walter Edge, Pierre Laval, Aristide Briand, P. E. Flandin, F. Pietri, and A. F. Poncet. Such initialed memoranda usually mark the agreement, sealed formal treaties being signed later.

Thus for more than ten years Europe failed to find real peace and a chance to rebuild prosperity. Then, economic depression set in; and as it progressed, more and more of the treaty arrangements broke down.

The territorial arrangements concerning Turkey, Poland, and Fiume already had been modified; and in January 1935, the people of the Saar, in a plebiscite which had been provided for in the peace treaty, voted overwhelmingly for return to Germany. The treaty provisions for reparations had been modified step by step. The Allied nations still retained mandates over former German colonies; but occupation of the Rhineland by Allied troops had ceased. The only unchanged portions of the Versailles Treaty dealt with certain territorial arrangements, and with restrictions upon Germany's military power. When Hitler became the head of the German government in 1933, he announced his intention to put an end to these restrictions but at first he took no action openly. After the Saar plebiscite showed his popular support, he at once repudiated every military limitation in the treaty. And in March 1936, he reoccupied the Rhineland with German troops, and began demanding the return of former German colonies. The Allied nations, weakened by the depression and fearing to provoke another war, could only protest and try to meet the German challenge by increasing their own armaments.

It soon became clear that another war was in the making. Italy, allying itself with Germany, seized Ethiopia and Albania. Germany took Austria and Czechoslovakia. To these acts France and England offered no military resistance, but when Hitler's troops invaded Poland Sept. 1, 1939, they declared war on Germany. (For a detailed account of the new war. see World War, Second.)

Second World War



Flaming Dunkirk Symbolizes the Terror and Destruction of the Greatest War in History

WORLD WAR, SECOND. Germany's invasion of Poland in 1939 started what was soon recognized as a second World War. Europe was the early theater of conflict; but the fighting rapidly spread over more sections of the earth's surface than were involved in any previous conflict. The war raged in the deserts and jungles of Africa and in the Near Eastern nations of Syria, Iraq, and Iran. The war between Japan and China, in progress since 1937, became part of the larger conflict. Then in December 1941, Japan drew in the United States, and the entire Pacific Ocean area flamed into war. (For a chronology of events, *see* **World War II** in the FACT-INDEX.)

For the first three years the tide of victory was almost wholly in favor of Germany and the nations joined with it. But toward the end of 1942 the Allies first halted further Axis expansion, then began to close in. On May 8, 1945, Germany finally surrendered, and Japan followed suit on September 2.

How One War Led to Another

IN THE 21 years between the first and second World Wars, many problems arose that cried for solution. These problems, and the efforts of the nations to solve them, are discussed in the articles on Europe and on the first World War (under the heading "The Peace and Its Results"). Empires had fallen and new nations had been created. The economic system of Europe was in a state of collapse. There were huge debts and appalling damage. Political upheavals and revolutions swept the continent. Everywhere arose the cry that out of the ruins must rise a new Europe.

But the Europe created by the Treaty of Versailles in 1919 was not new. On a map it looked different: many frontiers had been changed. Statesmen said it was different: they pointed to the League of Nations. But the tragic fact was that the ink on the treaty had not dried before the rulers of Europe resumed the same intrigues and secret maneuvers that had characterized European "power politics" for centuries.

Even the form adopted by the age-old struggle for power was not new. It was, simply, the relationship of the victor to the vanquished. The Versailles Treaty had imposed on Germany terms which President Wilson, one of the authors of the treaty, called "severe." To enforce those terms—to remove forever the threat of German power—became the major object of Allied diplomacy in the postwar years.

But at the very outset there were forces which challenged Anglo-French rule in Europe. In Russia the war had given birth to a new Soviet system, whose aim was to establish communism at home and throughout

the world. In Italy, in 1922, an ex-socialist named Benito Mussolini came to power and set up a government based on principles which he called fascism. In the Balkans, in central Europe, and along the Baltic, nations fell under the rule of dictators.

Despite these alarming signs of change, the Allies by their overwhelming military and economic supremacy were for a time able to enforce their will. France encircled Germany with a system of alliances in the east. The Allies dominated the League and frequently used it as the implement of their power. There were efforts at disarmament, but no thorough and effective limitations of arms resulted from them.

Though it did not rest on any very stable foundation, a victors' peace prevailed for a period, notably from 1924 to 1929. Then depression—a depression which had been in the making since the end of the war —burst upon the world. The depression came ten years after the Treaty of Versailles and ten years before the outbreak of the second World War. It marked, in a very real sense, the end of the "postwar" period and the beginning of the new "prewar" period. For if the war and its aftermath produced the depression, the depression in turn was to set in motion forces which would eventually plunge the world into a new and greater conflict.

The Period of Aggression

To THE UNREST of the 1920's, the economic depression added appalling misery. Everywhere poverty crystallized opposition to the existing order. The crisis gave new support to systems of government opposed to democracy and to the ideals of international relations symbolized by the League of Nations. One such form of government was the totalitarian state, in which the nation is regimented by a dictator at home for the purpose of expansion abroad. (*See* Dictatorship; Fascism.)

It was natural that the totalitarian idea should take root in the nations that regarded themselves as having an unduly small share of the world's wealth and territory. These were the "have-not" nations, Germany, Italy, and Japan. Their opponents were the democracies, or the "haves." The 1930's were dominated by the struggle between these rival groups of powers. Beginning in 1931, when Japan invaded Manchuria, and accelerating after 1933, when Hitler came to power in Germany, the totalitarian states pursued a program of aggression whose ultimate aim was world domination.

'Mein Kampf' States Hitler's Intentions

The path of aggression was charted by Hitler in his book 'Mein Kampf'. There he stated these broad objectives: (1) renunciation of the Versailles Treaty, with its "intolerable" accusation of German guilt for the first World War; (2) restoration of his country's military power; (3) acquisition of new territories, especially those with large numbers of German-speaking people, as "living space" (*Lebensraum*) for Germany's crowded population; (4) establishment of the Germans as the "master race" in Europe.

To accomplish this last objective, Hitler foresaw the necessity of annihilating Germany's "mortal enemy," France. In this he counted on Great Britain and Italy as allies, for he believed it was in the interest of all three to wipe out French domination of the continent. Once he freed his country of the danger of attack in the west, Hitler proposed then to pursue his major purpose—a drive to the east (*Drang nach Osten*) against Russia, whose broad rich expanse would provide unlimited opportunities for the industrious Germans.

Actions of the Aggressors

Except for his failure to win Great Britain as an ally, Hitler after his rise to power was able to follow closely the pattern laid down in 'Mein Kampf'. At first the totalitarian states pursued independently their programs of expansion. Japan consolidated its gains in Manchuria; Italy in 1935 invaded Ethiopia; and Germany in 1936 reoccupied the Rhineland. But mutual interests inevitably drew the aggressor nations together.

The first opportunity for joint action came when civil war broke out in Spain in July 1936. Germany and Italy aided the fascist rebels with arms, technicians, and troops. Their aid was given on the ground that the rebels were fighting a communistic régime supported by Soviet Russia. To implement this policy of opposition to the Soviet Union, Germany and Italy formed the Rome-Berlin Axis. Japan, which feared both Russia and the democracies, was drawn into the alliance through the anti-Comintern pact.

This formidable coalition was then in a position to pursue an even bolder policy of aggression. In 1937 Japan invaded China. Germany in March 1938 sent troops into Austria. The occupation of Austria was hardly completed when Hitler opened a campaign for the German-speaking portions of Czechoslovakia. In September, at a conference at Munich, he gained the consent of Great Britain and France to the surrender of the Sudeten regions; and six months later, in defiance of a British and French guaranty, he seized most of the remainder of the country. The same month, March 1939, the Spanish republic finally collapsed under the continued assault of the Axis-supported rebels. And the following month, while attention was diverted elsewhere, Italy annexed Albania.

Policies of the Anti-Fascist Nations

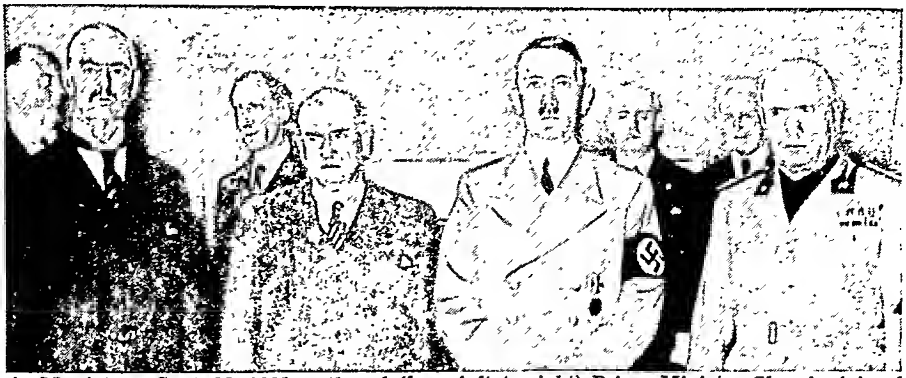
What enabled the totalitarian states to carry out this incredible program of aggression? How could Hitler plainly set forth a plan for the conquest of Europe and then methodically proceed, without effective opposition, to put the plan into action? What was the rest of the world doing?

During the period of aggression, from 1931 to 1939, three factors were decisive in shaping the policies of England and France: (1) these nations were weakened by internal dissension; (2) their peoples, animated by a profound desire for peace, had insisted on general reduction in armaments; and (3) they hoped to turn the tide of aggression eastward, against Soviet Russia. Upon all these factors Hitler played with Machiavellian skill. Alternating threats of

war with promises of peaceful intentions, vowing always that his real enemy was Russia, he induced the democracies to stand aside.

Soviet Russia against which the fascist coalition had presumably been formed, tried to draw England, France, and other peaceful nations into a plan to stop aggression. It vigorously supported the system of "collective security," under which all nations, through the League, would guarantee the independence of each. In 1935, to reinforce this policy, it formed mutual assistance pacts with France and Czechoslovakia. But this system of alliances broke down at the Munich conference of 1938, when Russia was excluded from negotiations in which France permitted Germany to dismember Czechoslovakia.

SEEKING PEACE BY "APPEASEMENT"



At Munich on Sept. 29, 1938, gathered (from left to right) Prime Minister Chamberlain of Great Britain, Premier Daladier of France, Chancellor Hitler of Germany, and Premier Mussolini of Italy. Submitting to threats of war, the Allied leaders agreed to let Hitler cut up Czechoslovakia—his "last territorial demand in Europe."

The United States protested the actions of Germany, Italy, and Japan, and as early as 1937 President Franklin D. Roosevelt advocated a policy of "quarantining" the aggressor, but this policy found little support. In southeastern Europe, in the Baltic and Scandinavian states, in Latin America—in fact, over most of the world—totalitarian aggression aroused indignation and fear; but the failure of England and France to provide leadership prevented the formation of a strong antifascist alliance.

Abandonment of "Appeasement"

The end of the British and French policy of "appeasement"—that is, of making concessions to the dictators—came after Germany's partition of Czechoslovakia in March 1939. Hitler's flagrant violation of his own pledge and his contemptuous defiance of the democracies finally united Great Britain and France in their determination to stop aggression.

Therefore Prime Minister Chamberlain of Great Britain and Premier Daladier of France (*see* Chamberlain, Arthur Neville; France) promptly pledged aid to Poland in case of Nazi attack; and in April they extended similar guaranties to Greece, Rumania, and Turkey. In defiance of the Anglo-French pledge to Poland, Hitler demanded the return of Danzig to the Reich and the cession of a strip of territory linking East Prussia with the rest of Germany. Poland immediately rejected these demands. Chamberlain warned that the attempt to annex Danzig or any part of Polish territory by force would meet with the armed resistance of Great Britain.

The Soviet-German Pact

Faced with an immediate threat of war, England and France on one side and Germany on the other began a diplomatic struggle to win the support of other nations in Europe. In May Germany converted the Rome-Berlin Axis into a formal military alliance with Italy, whereby each nation was pledged to support the other in war. England and France meanwhile conducted negotiations for a pact with Russia. But they did not pursue the negotiations with vigor, partly because of their reluctance to form a tie with Russia and partly also because Poland refused to let Soviet troops cross Polish soil in the event of war.

Hitler, on the other hand, was willing temporarily to renounce his bitter and contemptuous opposition to the Soviet system in order to avoid fighting a major war on two fronts. For, in the opinion of German military leaders, victory in the west required that Germany should not have to fight Russia in the east at the same time. Russia, in turn, feared that the failure of its negotiations with the democracies would place it in an isolated position. So the ground was laid for one of the most astonishing reversals in modern diplomatic history. On August 24, 1939, Germany and Russia signed a 10-year nonaggression pact which provided that neither nation would "associate itself with any other grouping of powers directly or indirectly aimed at the other."

Diplomacy Fails to Avert Conflict

The following day England converted its verbal pledge to Poland into a written military alliance. At the same time Chamberlain sought to bring about direct negotiations between Poland and Germany for settlement of their dispute. On August 29 Hitler agreed, on condition that Poland within the next 24 hours should send an emissary to Berlin with authority to conclude a settlement. When Britain protested against the haste and unfairness of this proposal, Germany replied on August 31 by making public its terms for settlement of the Polish dispute. These included the immediate return of Danzig to Germany and a vote (plebiscite) by the inhabitants of the Polish Corridor to determine whether the corridor should remain Polish or go to Germany. When the Polish ambassador to Berlin attempted to transmit these proposals to his government, he was unable to do so because the lines of communication had been cut.

The next morning, September 1, Germany annexed Danzig and invaded Poland. On September 3 England and France sent ultimatums to Germany demanding the immediate withdrawal of German troops from Poland. When Germany refused, England (at 11:00 a.m.) and France (at 5:00 p.m.) declared war. Within

a week Great Britain was joined in war by its dominions of Canada, Australia, New Zealand, and South Africa, and by India. The only portion of the British Commonwealth to remain outside the conflict was Ireland (Eire).

The Winter of 1939–40

THE OUTSTANDING military feature of the new world conflict was Germany's military tactic of total war —*Blitzkrieg*, or "lightning war"—a combination of crushing bombardment from the air with swift invasion by highly mechanized units on land. The offensive is sudden and ferocious. Successfully executed, it demoralizes the defenders before they can comprehend the plan of attack and organize to meet it; and so it leads to quick surrender.

It was *Blitzkrieg* in all its incredible fury that the Germans launched against Poland on Sept. 1, 1939. Relying on its strong western fortifications to hold off an allied attack, Germany flung the full weight of its military machine against the Poles in an effort to eliminate this eastern front.

Campaign in Poland

The Poles fell easy victims to the German invaders. The first day German aviation destroyed Poland's flying fields and bases, and within a week it had crippled lines of communication. Simultaneously, German *Panzer* (armored and mechanized) divisions, by a series of encircling movements, enveloped Polish armies in the northwest and southwest. The Germans then converged on the main Polish forces pocketed in the region around Warsaw. Retreat turned into a disorganized rout on September 17, when Russia sent its armies across Poland's eastern frontiers. The besieged people of Warsaw continued to maintain a desperate, gallant resistance, but furious pounding by artillery and aviation finally forced them to surrender on September 27. The next day Germany and Russia concluded a treaty in Moscow dividing Poland between them.

The Russo-German partition, the fourth in Poland's history, divided the country by a line running roughly along the Bug and San rivers. The western part occupied by Germany contained about 45 per cent of the area, 60 per cent of the population, and the richest farm and industrial regions. Russia took the remainder, mostly agricultural and forest land. In October Hitler formally annexed the provinces of Pomorze, Posen, and Upper Silesia to the Reich; and he appointed a Nazi governor general to rule the rest of German Poland, including Warsaw. Continuing the struggle against Germany with the Allies were the Polish government officials, soldiers, airmen, and naval units that managed to escape the swift Nazi advance. (*See also* Danzig; Poland.)

NAZI-SOVIET PACT OF 1939

Soviet Foreign Commissar Molotov signs a pact of non-aggression between Germany and Russia, as German Foreign Minister Ribbentrop and Stalin look on smilingly.

Stalemate in the West

In contrast to Germany's new methods and strategy of warfare, as demonstrated in the Polish campaign, England and France were committed to almost exactly the same military plan they had used in the first World War. The cornerstone of this plan was the blockade of Germany by the Allied fleet. The blockade was expected to reduce Germany to utter privation and thus compel the Nazis to launch a disastrous offensive against the French army and the Maginot fortifications, which the Allies believed were impregnable. Entrenched behind these massive defenses, the Allies complacently settled down for a long war in which their superior resources, they thought, would eventually vanquish Germany.

The Germans with equal confidence relied for defense on their Siegfried line, similar to the Maginot line in construction and paralleling its position. But to them inactivity on the Western front during the winter of 1939–40 provided a welcome opportunity to replenish their military forces after the campaign in Poland. A further reason for their inaction during this period was the unsuitability of winter weather for *Blitzkrieg*, which requires clear skies for planes and dry ground for tanks and other motorized units. Thus, both sides failed to launch any large-scale offensive in the west during the war's first winter.

War on the Sea

In contrast to the early stalemate of land warfare in the west, the war on the sea was exceedingly active. Great Britain and France used their tremendous naval power to prevent Germany from receiving war materials, food, and other vital supplies. They later extended the blockade to include Germany's exports as well, and they rationed supplies to neutral countries that were in a position to reship to Germany.

Germany in turn launched a counterblockade, and its submarines, mines, and depth bombs took a heavy toll of Allied merchant and passenger vessels. Nevertheless, Great Britain and France retained control of the major sea lanes; and neutral and Allied ships, convoyed by destroyers and planes, brought them a steady flow of supplies. (*See* Blockade.)

Despite the clash of blockade and counterblockade, there was at first no large-scale test of strength between the Allied and German fleets, such as occurred in 1916 in the Battle of Jutland. Naval warfare never-

theless produced many spectacular exploits. In December 1939 a dramatic sea battle took place off the coast of South America. Three British cruisers damaged the German raider *Admiral Graf Spee*, forced it to take cover in the harbor of Montevideo, and, by trapping it there, compelled its captain to sink the ship rather than risk capture. Another daring British naval venture was undertaken in February 1940. The British destroyer *Cossack*, invading Norwegian territorial waters at Josing Fiord, rescued 300 British seamen who had been captured during the *Graf Spee's* raids and who were aboard its consort, the *Altmark*. Of the German naval victories, the most sensational was a raid in Scapa Flow. On Oct. 14, 1939, a German U-boat penetrated this British naval base and torpedoed the battleship *Royal Oak*.

Policies of Nonbelligerent Nations

Among the nations not involved in the conflict at its outbreak, there were efforts to preserve neutrality and, if possible, to bring about a peace before the commencement of large-scale hostilities. King Leopold of the Belgians, Queen Wilhelmina of the Netherlands, and President Roosevelt, as well as Pope Pius XII, attempted unsuccessfully to intervene for peace.

Despite diplomatic pressure by the belligerents, few nations at first openly took sides. As in the first World War, Italy failed to carry out its pledge of immediate aid to Germany at the outbreak of hostilities. Mussolini nevertheless asserted that his country was a "nonbelligerent ally" of the Reich, and by his threatening attitude compelled France to divert part of its forces to the Italian frontier. Spain, Hungary, and Japan, also linked to Germany through the anti-Comintern pact, adopted a similar attitude of purely verbal support of the Nazis. Turkey, in May 1939, agreed to aid England and France against any power except Russia if war spread to the Mediterranean area. Most nations, however, awaited developments before making any decisive moves.

Russo-Finnish War and Soviet Expansion

Of these nonbelligerent nations, the one which pursued the most enigmatic policy at this time was Soviet Russia. It denounced both sides in the war as "imperialist" powers and announced that its aim was to strengthen itself against a possible attack by either of the belligerents. To this end, the Soviet Union in September and October 1939 compelled Estonia, Latvia, and Lithuania to grant it military bases and far-reaching diplomatic concessions. But the attempt to impose similar terms upon Finland met with firm resistance; and so, on November 30, Russia invaded the country.

Though immense Soviet superiority in numbers was expected to overwhelm Finland in short order, the Finns surprised the world by putting up a sturdy fight. Aided by the intense cold, by their Mannerheim line of fortifications along the Karelian Isthmus, and by their familiarity with the rugged and broken terrain, they repulsed the invaders with heavy losses in the first few months. But persistent bombardment by planes and heavy artillery finally achieved a breakthrough of the Finnish defenses. On March 12, 1940, Finland signed a peace treaty which granted the Soviet Union an important slice of Finnish territory, including the Karelian Isthmus and the port of Viipuri (Viborg). (*See* Finland.)

Russia further strengthened its strategic position in June, when it compelled Rumania, under threat of invasion, to cede Bessarabia and northern Bucovina. Meanwhile it increased its penetration of the Baltic States. This culminated early in August when Lithuania, Latvia, and Estonia voted, under pressure, to become new republics of the Soviet Union (*see* articles on those countries). Along its entire frontier with Germany and German-dominated territory, Russia now occupied new lands which would serve as a buffer in the event of a Nazi attack.

German Invasion of Denmark and Norway

As SPRING THAWED the fields of Europe, the world nervously awaited the end of the winter lull. Where and when would Germany strike? Hitler chose Scandinavia, to attain several vital objectives. First, control of the coast of Norway as a springboard for an eventual attack upon Great Britain. Second, use of the Norwegian coast as a base of operations against the Allied blockade. Third, occupation of Denmark and Norway to safeguard Germany's supply of Swedish iron ore and to open up all the rich resources of Scandinavia.

Pretext for Germany's drive to the north came on April 8, 1940, when the Allies announced the laying of mine fields off the coast of Norway. Early the next morning Germany invaded Denmark and landed troops in Norway. Occupation of these countries for the duration of the war was necessary, the Nazis claimed, to forestall an Allied attack on Germany through Scandinavia.

Denmark, incapable of resisting, accepted the "protection" which Germany offered the two countries. Within a day it was occupied by the German army. King Christian X was retained as nominal ruler, but the country was governed in effect by the German army of occupation. Norway, however, instantly declared war, and it received a pledge of "full aid" from Great Britain and France.

Campaign in Norway

The first day of their invasion the Nazis seized Oslo, the capital, and most of the other important coastal cities of Norway. British naval and air forces promptly engaged Nazi troop transports, but, though they inflicted heavy losses, they were unable to prevent the Germans from bringing supplies and reinforcements to their coastal garrisons. On April 14 British expeditionary troops were landed in Namsos and Aandalsnes, to reinforce the disorganized Norwegian forces. But they were unable to stem the swift advance of German columns moving north from Oslo; and when these columns established connection with the German base at Trondheim, the Allied defense in Norway was doomed. On May 1 to 3 the

British forces were evacuated. They regained a foothold at Narvik, in the far northern part of the country, but were forced to withdraw on June 9. The same day King Haakon VII of Norway announced that his country had surrendered to the invaders. He and his government fled to England, where they continued the struggle against the Germans (*see* Norway).

GESTAPO AND "FIFTH COLUMN"

Heinrich Himmler, chief of the German secret police (Gestapo), gives the Nazi salute to leaders of the "fifth column" in Norway. The bareheaded man at Himmler's left is Quisling, head of the Norwegian Nazis.

In its conquest of Norway, Germany was greatly aided by the work of its "fifth column"—Germans living in the country and also Norwegian Nazis, under the leadership of Major Vidkun Quisling. These people assisted the invaders by issuing false military orders, by creating confusion and dissension among civilians, and by taking part in the "puppet" government through which Germany later ruled the country. The term "fifth column" was derived from the Spanish civil war of 1936–39, when the fascist general Mola, leading four columns of troops on Madrid, boasted that he had a "fifth column" of sympathizers within the enemy's gates. Another term applied to such traitors was "Quisling," from the name of the Norwegian Nazi.

Conquest of the Low Countries and France

WITH THE Norwegian campaign virtually concluded by the end of April, Germany was ready to launch the decisive offensive in the west. Its plan of attack called for a defensive left wing which would hold the French along the fortified Rhine frontier, while an irresistibly powerful right wing swept through the plains of Belgium and the Netherlands into northern France, and then circled southward and eastward to attack the French fortifications from the rear.

Invasion of Holland, Belgium, and Luxemburg

Suddenly, before dawn on May 10, the great offensive began. The German army and air force invaded Belgium, the Netherlands, and Luxemburg. Again, as in the case of Norway, the Germans attacked the neutrals first and explained later; and again the explanation was that they were moving to forestall an Allied attack.

Luxemburg, tiny and defenseless, was occupied by the Germans without resistance within a day (*see* Luxemburg). Belgium and the Netherlands instantly declared war, and appealed to France and Great Britain for aid. Great Britain called Winston Churchill, dynamic first lord of the admiralty, to replace the aged Neville Chamberlain as prime minister (*see* Churchill, Winston). And the Allies instantly sent troops into the Low Countries, to try to stop the Germans.

The Battle of Flanders

This time the German *Blitzkrieg* opened with a startling novelty. Troops landed by parachute seized strategic bridges and forts before the Dutch could carry out their plans for flooding the country or the Belgians could organize their main line of defense along the Albert Canal. As tanks and motorized units overran Holland's lowlands, planes mercilessly bombed Rotterdam and other Dutch cities. On May 14 the Dutch army, pushed back to the sea, was ordered by its commander to cease fighting. All Holland was quickly brought under the rule of German forces of occupation. Queen Wilhelmina, who had fled to London, formed an "exile government" there which retained the allegiance of the Netherlands Indies and the rest of the rich Dutch empire (*See also* Netherlands.)

In Belgium, a German mechanized column cut across the Albert Canal and thrust ahead toward Brussels, to merge with the forces pressing down from Holland. To the south, dive bombers and tanks broke Allied resistance along the Meuse at Sedan and Dinant, and through these gaps the Germans raced for the Channel. If the Allies had been prepared to pinch off these advance troops, the German left flank thrust would have been suicidal. But the Germans reached the Channel at Abbeville on May 21, and hastily reinforced this line so that it held against belated and scattered French attacks from the south.

The British, French, and Belgian troops in Flanders were now caught in a pocket with German forces converging on them. King Leopold of Belgium, convinced that further resistance was futile, surrendered his army on May 28. The Allies then had no choice but to attempt an escape by sea. Mustering every available vessel and gaining temporary control in the air, the Allies, from May 29 to June 4, evacuated more than 335,000 men from Dunkirk in one of the most remarkable naval operations in history. (*See* Belgium; Dunkirk.)

Italy Enters the War

On May 19 General Gamelin had been replaced by Gen. Maxime Weygand as commander in chief of the Allied armies. Weygand attempted to organize a line of defense along the Somme and Aisne rivers, where the French might hold the advancing Germans. On June 5 the Battle of France began with a great German

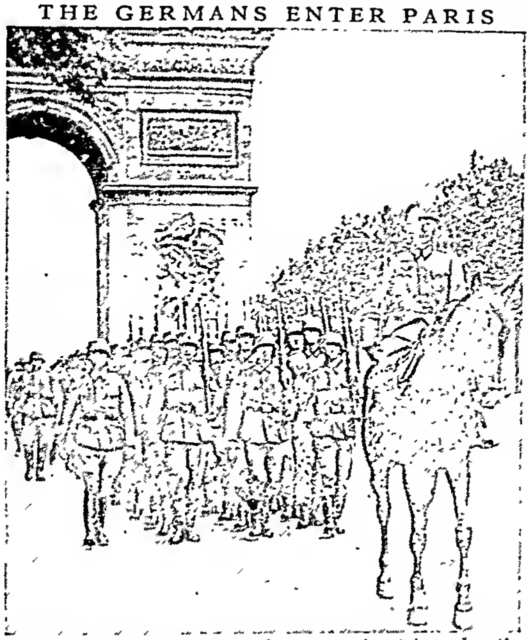
offensive along a front extending more than 100 miles from near Laon to the Channel. Throwing huge reserves into the battle, the Germans smashed through the weakened and disorganized French forces and headed for Paris.

At this juncture, on June 10, Italy declared war on Great Britain and France. Mussolini asserted that Italy was engaging in a crusade against the democracies, but it was evident that, with France nearing defeat, the dictator was only seeking a share of the spoils. Italian troops saw almost no action in the Battle of France.

Fall of France

On June 11 the French government moved to Tours and later to Bordeaux. Paris, which had been declared an "open city" by the French to spare it from destruction, was occupied by the Germans June 14. Meanwhile the Germans advanced almost without opposition through central France, taking the Maginot fortifications from the rear. There were desperate efforts to avert the imminent French collapse. Premier Paul Reynaud of France addressed an urgent appeal to President Roosevelt for "clouds of war planes" and for a public declaration of United States aid. Prime Minister Churchill attempted to bolster French morale by proposing an immediate economic and political union of Great Britain and France. But these efforts were of no avail, and on June 16 the French cabinet voted in favor of an armistice. Marshal Henri Pétain, the 84-year old hero of the first World War, became premier. The next day he petitioned the German government to state its terms.

THE GERMANS ENTER PARIS



Hitler's army of conquest here parades triumphantly through the Arc de Triomphe, symbol of French military glory. Paris had been abandoned to the advancing Germans to prevent the city's destruction.

The Franco-German armistice was signed June 22 in the forest of Compiègne, in the same railway car in which a victorious France had dictated its terms to a beaten Germany 22 years before. The armistice provided for German occupation, at French expense, of more than half of France, including its entire Atlantic coast and all its northern area to a line extending from Geneva almost to Tours. The French were to demobilize and disarm all their troops, excepting only those needed to maintain order at home and in their colonies. They also had to turn over all military supplies to Germany. The Franco-Italian armistice, concluded June 24, compelled France to demilitarize its frontier with Italy, its strategic colonial outposts in Africa, and certain naval bases in the Mediterranean. With the signing of the Italian armistice, the war in France formally ended. The armistice terms were to remain in effect until the conclusion of a peace treaty.

The astonishing ease with which French resistance had crumbled under German assault was attributed by most observers to a combination of military weakness and political decay. Confusion and dissension had long existed in every aspect of French national life.

In July the government of unoccupied France, from its headquarters at Vichy, voted out of existence the democratic French parliament. Upon the ruins of the Third Republic, Marshal Pétain built a fascist state in which he, as president and premier, held dictatorial power. As the war progressed, the Vichy government, under the influence of men like Admiral François Darlan and Pierre Laval, "collaborated" with Germany to the extent of rendering France a virtual Nazi puppet. Opposed to this course were the remnants of the French forces which had reunited in England to carry on the struggle against Germany under the leadership of the French general Charles de Gaulle. Though these "Free French" were bitterly assailed by the Vichy government, and their partisans in unoccupied France punished as "traitors," they won wide support from the French people, both at home and in the empire.

A major concern of Great Britain after the fall of France was to prevent the French fleet from falling into Germany's hands. Some French vessels joined the British, and some were interned in British harbors. One force which resisted was all but destroyed by the British fleet at Oran, Algeria. As a reprisal for this action, the French government broke off diplomatic relations with Great Britain, thus severing an alliance which for a generation had played a dominant rôle in European affairs.

Battle of Britain and the Atlantic

HITLER EVIDENTLY expected that the fall of France, with the consequent collapse of Allied power on the continent, would bring about a swift British capitulation. In July he urged Great Britain to conclude peace with Germany. Churchill rejected the proposal and reaffirmed Britain's determination to fight on until Hitlerism was defeated.

At this point the war pitted against each other a great continental land power, Germany, and an island sea power, Great Britain. Except for the additional factors introduced by the airplane, the struggle in broad outline had assumed a striking resemblance to the classic phase of the Napoleonic wars in which France ruled the continent and Britain ruled the seas. It remained to be seen whether air power would end the deadlock.

At the outset of the war, Hitler had threatened a mass aerial offensive against England. His threat was finally carried out in mid-August of 1940. Almost daily, hundreds of German planes swarmed across the Channel from bases in occupied France and bombed England from end to end. Industrial cities such as Coventry, Birmingham, and Manchester, and ports such as Liverpool, Southampton, and Portsmouth were pounded unmercifully. London was raided night after night, with terrible damage to its historic buildings and monuments. Aerial bombs wounded and killed many civilians, and the entire population was subjected to terrific strain and hardship. The German aerial offensive appeared to have two objectives, preliminary to an invasion of England—first, to gain control of the air over England; and, second, to break the morale of the British people. Neither objective was achieved. The Royal Air Force brought down the invading planes at a crippling rate and clearly demonstrated an ability to break up any German mass assault. The R. A. F. furthermore took the offensive, bombing Germany, Italy, and Axis-occupied territory, and particularly the "invasion ports" along the Channel coast. The British people, undismayed by German attacks, only increased their efforts to make England an "island fortress," which could repel any invasion attempt.

FRANCE BOWS TO A GERMAN ARMISTICE

Wilhelm Keitel, commander of the German armed forces, stands to read the armistice terms to the French delegates. Hitler sits at Keitel's right.

Campaign against British Shipping

Along with its stepped-up aerial campaign against England, Germany intensified its efforts to establish an effective blockade. The blockade struck at the heart of Britain's resistance—its control of the sea lanes to bring the supplies from its empire and the United States which were vital not only to prosecution of the war but to life itself. Germany's conquests had given it bases along the entire Atlantic coast of Europe from Bordeaux to northern Norway. Operating from these bases, German submarines and planes struck with deadly effectiveness at merchant shipping in the north Atlantic. Allied ships, with their precious cargoes of food, raw materials, planes, and munitions, were being sunk at a rate several times greater than the combined capacity of Great Britain and the United States to build new vessels.

Against the menace of German raiders, Britain convoyed its shipping with destroyers and planes. That these Atlantic patrols were not more effective was due in part to the fact that the British fleet was compelled to divert much of its strength to the Mediterranean. Another factor was that convoys, though they might ward off destroyers, were an easy target for planes. For victory in the "battle of the north Atlantic," Great Britain relied, in the final analysis, on American aid.

The Far East in the War

During the comparative lull after the fall of France and the subsequent siege of Britain, new lands outside Europe gained the spotlight in the spreading conflict. Among the areas vitally affected by the extension of the war was the Far East.

Background of the Sino-Japanese Conflict

When the second World War broke out, Japan was in the third year of its struggle to conquer China. The aggression in China was part of Japan's long-range program of expansion in Asia. In domestic affairs, the imperialist program had brought Japan under the rule of a totalitarian dictatorship; in foreign policy, it had, as we have seen, lined up the country with the other aggressor nations. (*See* Japan.)

But the Chinese people, under the leadership of Gen. Chiang Kai-shek, defended fiercely their vast land and its new democracy (*see* Chiang Kai-shek). Aided by supplies and technical assistance from Soviet Russia, the United States, and Great Britain, they fought the invaders with incessant guerrilla warfare that bogged down the Japanese armies in China and seriously endangered the war-minded ruling clique at home. (*See* China.)

Because of this, the Japanese sought gains elsewhere. The involvement of the western nations in war in Europe, and the withdrawal of much of their strength from the Far East, seemed a tempting opportunity. Remaining neutral in the war in the west, Japan undertook to spread its dominion throughout eastern Asia.

Japan in East Asia

Germany's conquest of the Netherlands and France, leaving relatively undefended the rich Netherlands Indies and French Indo-China, gave Japan its first great chance. In French Indo-China Japan, by threatening invasion, obtained in September 1940 air bases and garrisons for use against China. At the same time Japan encouraged Thailand (Siam) to attack French Indo-China. Meanwhile Japan, by propaganda and further military infiltration, strengthened its hold on the entire French colony.

Japan's alliance with the Rome-Berlin Axis in a policy of expansion was plainly stated in a pact signed with Germany and Italy Sept. 27, 1940. The pact joined the three nations in an effort to create a "new order" in which Germany and Italy would be

dominant in Europe, and in which Japan would assume leadership in "Greater East Asia." The three powers further agreed to fight together in the event of attack by any nation not then engaged in war. Japan sought nevertheless to minimize the possibility of getting into the European conflict. In April 1941 it concluded a nonaggression pact with its old enemy Russia that committed the two nations to a position of neutrality in any war in which either was engaged.

Obstacles to Japanese Expansion

Despite Japan's hope of profiting from the war, many obstacles continued to hamper development of its ambitious program in east Asia. Its best military and diplomatic efforts were unable to conclude the war in China, and China continued to receive aid from the United States and Soviet Russia. The United States concentrated its fleet in the Pacific and imposed increasingly severe economic sanctions on Japan. Britain, by its control of Singapore, held the key to power in southeastern Asia (*see* Singapore). Soviet Russia, despite the nonaggression pact, was still another threat to Japan. Menaced thus on many sides, Japan pursued a cautious policy, seeking profit for itself in the rivalries and conflicts of the other powers. (*See also* Pacific Ocean.)

The United States Helps the Allies

THE OUTBREAK of war aroused in the people of the United States an almost unanimous determination to stay out of Europe's quarrels. There was overwhelming aversion to Hitler and his Nazi Germany; there was keen sympathy for Great Britain and France, and even willingness to lend them material and moral support; but there was, above all, the desire to remain neutral in a war which, many at first believed, neither menaced nor directly concerned the United States.

In accordance with public opinion, the government adopted measures having three broad objectives. The first was to lend aid to the Allies within the limits of the country's policy of neutrality. To this end, Congress in November 1939 amended the Neutrality Act to permit Great Britain and France to purchase implements of war from the United States on a "cash-and-carry" basis. The second objective was to rearm for defense, and the administration forthwith launched the largest rearmament program in the nation's history. The third aim was the immediate strengthening of ties with the other nations of the Western Hemisphere.

Defense of the Western Hemisphere

For years before the war the Roosevelt administration, by its "good neighbor" policy, had laid the basis for joint action by the 21 American republics in the face of any crisis. The war proved and strengthened Pan American solidarity. In October 1939 the United States joined the republics of Latin America in establishing a "safety belt" averaging 300 miles in width around the Americas south of Canada. Within this zone the warring powers were asked to avoid all hostile acts. In July 1940 the American republics adopted the Act of Havana, providing for joint trusteeship of any territories in the New World threatened with transfer from one non-American power to another. (*See also* Latin America.)

President Roosevelt's prewar pledge that the country would never permit Canada to be dominated by an invader was implemented by the creation, in August 1940, of a joint board for defense of the northern half of the Western Hemisphere. Hemisphere defense was further strengthened in September, when the United States transferred 50 over-age destroyers to Great Britain, in return for 99-year leases upon sites for air and naval bases in the British possessions of Newfoundland, Bermuda, the Bahamas, Jamaica, St. Lucia, Antigua, Trinidad, and British Guiana.

Response to the Fall of France

Meanwhile Germany's conquest of the Low Countries and France and Italy's entry into the war had left Great Britain and its empire fighting alone against the combined might of the Axis powers. This reorientation sharply altered the attitude of the American people. Whereas most of them previously had been "isolationist," the majority, according to polls of public opinion, now favored greater aid to England even at the risk of war. Most Americans felt that further German victories would directly threaten the security of the United States.

This new situation caused a speed-up of rearmament and the adoption of a policy of all aid to England, short of war. The objectives of the rearmament program were a "two-ocean" navy, strong enough to deal with any probable combination of foes in the Atlantic and the Pacific oceans at the same time; an army which could defend the United States and other nations of the Western Hemisphere against any possible aggression; and an air force of 50,000 military and naval planes. To build quickly an army capable of defending the vast expanse of the hemisphere, the nation in October 1940 adopted peacetime compulsory military service for the first time in its history. (*See also* Army; Navy.)

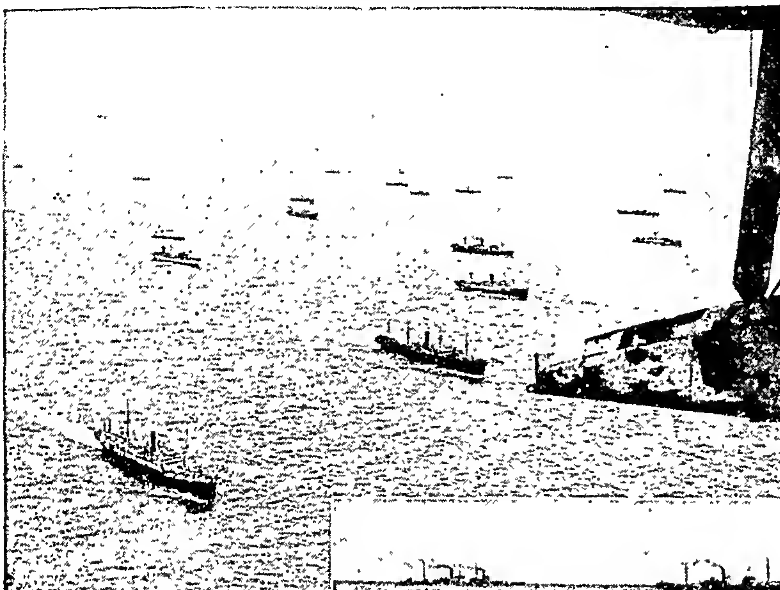
Early Efforts to Restrain Japan

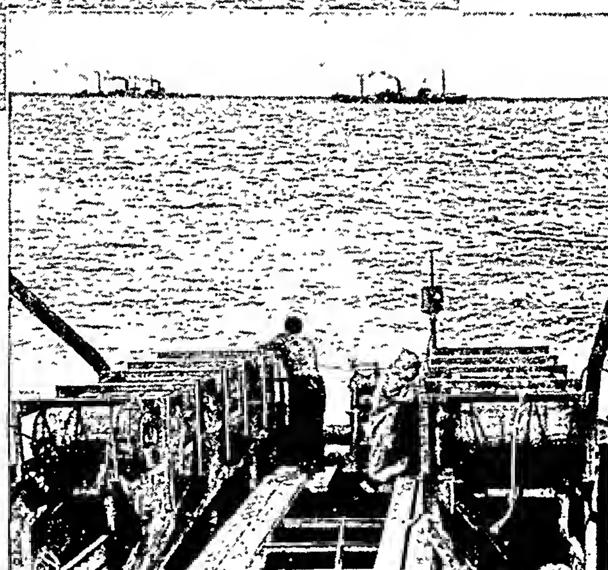
With the wartime alignment of Japan on the side of the Axis and of the United States on the side of the Allies, the conflicting interests of the two nations were thrown into sharp relief. The United States made clear its intention of preventing any attempt of Japan to dominate the Netherlands Indies, upon which American industry depended for supplies of rubber, tin, and other vital commodities. It also expressed opposition to Japanese aggression in French Indo-China. Backing up these moves, the United States concentrated its fleet in Hawaiian waters.

Effective nonmilitary action was permitted by Japan's economic dependence upon the United States. For supplies of scrap iron, petroleum, and copper to run its war machine; for cotton to feed its textile industry; and for foreign credits with which to trade abroad, Japan relied largely on American sources. In 1940 the United States government banned shipments of aviation gasoline and scrap iron and steel

to Japan and hinted at further embargoes if necessary. Meanwhile the immense productive machinery of the United States was functioning in high gear to make the nation the "arsenal of democracy." After Britain warned that it was nearing the end of its ability to pay for war materials, Congress in March 1941, granted the President authority to lend or lease arms and supplies to countries whose defense he deemed vital to the defense of the United States.

GUARDING CARGOES BOUND FOR BRITAIN





At the top, ships carrying American supplies to England are guarded by a British fighter plane, whose wing tip is just visible. Below, a British *corvette* is dropping a depth charge to blast out a submarine found lurking in the convoy's path.

Under the Lend-Lease Act, a steady stream of planes, tanks, guns, and other implements of war rolled off American assembly lines earmarked for Britain. To get these supplies across the Atlantic into the hands of British fighters in the face of highly destructive German raids on shipping, became a major problem. The President announced his determination to take any measures necessary to insure their delivery. To this end, as well as to strengthen hemisphere defense, the United States, on April 9, took Greenland under its protection for the duration of the war, by agreement with the Danish minister in Washington. For similar reasons, the United States, on July 7, landed naval forces in Iceland, with the permission of the island's government. American troops later replaced British soldiers stationed there. Patrols by the United States Navy reported the movements of German and Italian ships in the waters between the American Atlantic coast and Iceland.

With these moves, the United States dominated the approaches to its Atlantic shores. It held bases which would be of inestimable value in convoying supplies to Great Britain. It was also in a better position now to enforce in the North Atlantic the American policy of "freedom of the seas."

Diplomatic Clashes with the Axis

During the summer of 1941, as aid to Britain swelled in volume, relations between the United States and the Axis nations assumed a grim, unconcealed hostility. On March 30, the United States Coast Guard seized a number of German and Italian vessels in American harbors. On June 12, it was officially reported that the American freighter *Robin Moor* had been sunk by a German submarine in the Atlantic on May 21. The President condemned this as an act of "piracy," and said full reparations would be demanded of Germany. On June 14, the President "froze," or prevented the removal of, German and Italian assets. The next week he requested Germany and Italy to close their consulates and other agencies in the United States. In reprisal for these moves, the United States was ordered to close its consulates in Germany, Italy, and Axis-occupied countries. The President proclaimed the existence of an "unlimited national emergency."

United States Aims

As the United States drew nearer war, President Roosevelt laid before the world the broad principles which the nation was committed to support. In an address to the 77th Congress, Jan. 6, 1941, he said that the United States looked forward "to a world founded upon four essential human freedoms":

The first is freedom of speech and expression—everywhere in the world.

The second is freedom of every person to worship God in his own way—everywhere in the world.

The third is freedom from want, which, translated into world terms, means economic understandings which will secure to every nation a healthy peacetime life for its inhabitants—everywhere in the world.

The fourth is freedom from fear, which, translated into world terms, means a worldwide reduction of armaments to such a point and in such a thorough fashion that no nation

will be in a position to commit an act of physical aggression against any neighbor—anywhere in the world.

Struggle in the Mediterranean and the Near East

The failure to achieve a quick victory over Great Britain in the British Isles drove Germany and Italy into a campaign against British power in the Mediterranean region in the winter of 1940–41. This farflung offensive, along with the campaign against Allied shipping in the Atlantic, was intended to isolate and thus inevitably defeat Great Britain.

The British position in the Mediterranean was based on control of the two bottleneck passages to the ocean—Gibraltar at the western end and the Suez Canal in the east. It was against Suez that the Axis offensive was launched. An Italian attack in North Africa was coupled with a German drive through southeastern Europe. The ultimate objective of this vast pincers movement was to expel the British from the eastern Mediterranean, and thus to sever the important "lifeline" leading to the richest sections of the widespread British Empire.

ATLANTIC CONFERENCE OF THE DEMOCRACIES

Meeting aboard a battleship for their dramatic conference in August 1941 are (in the foreground) President Roosevelt and Prime Minister Churchill. Behind Churchill are Admiral E. J. King, commander of the U. S. Atlantic Fleet, and Gen. George C. Marshall, chief of staff of the U. S. Army. The civilian in the background is Sumner Welles, American undersecretary of state. At the far left are the President's sons, Ensign Franklin D. Roosevelt, Jr., and Capt. Elliott Roosevelt.

Italy's Failures in Africa and Greece

The new Axis campaign opened in August 1940 with an Italian invasion of British Somaliland. After brief resistance, the British made a strategic withdrawal from the colony. The following month Italy invaded Egypt from Libya, and the Italians advanced across the desert along the coast as far as Sidi Barrani. At the same time Italy made demands on Greece for the cession of strategic bases. When Greece refused to yield, Italy on October 28 invaded the country from Albania.

In all these ventures, Italy met disaster. In November the British navy dealt a crippling blow to the Italian fleet lying at anchor in Taranto. In December a surprise counterattack by British troops under the command of Sir Archibald Wavell drove the Italians out of Egypt and far back into Libya, destroying and capturing many men and a vast quantity of supplies. Meanwhile the Greeks fighting fiercely against superior numbers, routed the invaders and pushed into southeastern Albania. At the same time British troops struck at Italian East Africa from Kenya and the Sudan. In April 1941 they entered the capital of Ethiopia, and soon almost all of Mussolini's East African empire was in British hands.

Germany's Drive in the Balkans

In contrast to reverses at the Italian end of the Rome-Berlin Axis, Germany during this time had been successfully carrying out its campaign to gain the Balkan Peninsula. In August 1940 Rumania, under Axis pressure, had been compelled to cede northern Transylvania to Hungary and southern Dobruja to Bulgaria. Then in October the Nazi-dominated government of Rumania submitted to German occupation of the remainder of the country. Hungary was already under complete Nazi control. Bulgaria also fell to the Germans by occupation on March 1, 1941.

Hitler was now in a position to come to the aid of his Italian ally. Anticipating a Nazi onslaught upon Greece, Great Britain began to land an expeditionary force there. Germany attempted to complete the encirclement of Greece by drawing Yugoslavia into the Axis alliance on March 25; but the enraged Serbs quickly overthrew their government. Then, on April 6, German armies in Bulgaria and Rumania invaded Yugoslavia and Greece.

Campaign in Yugoslavia and Greece

Yugoslavia's ill-trained and outnumbered forces were quickly crushed by German armies in the flat northern part of the country. Hungary seized sections of its former territories in northern Yugoslavia, and Italian troops advanced along the Adriatic coast. On April 17, after 12 days of *Blitzkrieg*, Yugoslav resistance collapsed. Dismemberment of the young nation began when the Axis set up an "independent kingdom" of Croatia and placed a member of the Italian ruling house on the throne. At the same time Italy annexed outright part of the Dalmatian coast

In Greece, German armies driving down from Bulgaria overran Macedonia and Thrace, and then pushed west to make contact with the hard-pressed Italians in Albania. In the face of a concerted southward offensive the isolated northern armies of Greece surrendered April 23, and thereafter the Allied forces fought only to cover the re-embarkation of British expeditionary troops. By May 2, the Germans were

THE RISING TIDE OF NAZI CONQUEST—1939-42

March 15, 1939

May 28, 1940

June 10, 1940

March 1, 1941

June 25, 1941

November 8, 1942

In Contrast to These Maps Are Others on Page 265 Which Show How Allied Military Might Drove the Germans Back Again

in complete occupation. Later that month, German parachute troops descended upon Crete, and swiftly conquered the island.

Battle for the Near East

Along with their drive through the Balkans, the Germans entered the Near Eastern struggle. In April they redeemed Italian losses by expelling the British from Libya. At the same time Nazi propagandists intensified their campaign throughout the Moslem world. The prize at stake was the rich oil fields of Iraq, Iran, and Arabia.

In May the British suppressed a Nazi-supported revolt in Iraq. In Syria, also, Nazi infiltration had been progressing with the consent of the Vichy government of France. On June 8, British and "Free French" forces invaded Syria from the south. After a month of battle, the Allies forced the Vichy troops to accept an armistice, and occupied Syria and Lebanon. This put a stop to German schemes in the east and thus matched the deadlock in the west.

The advantage gained passed almost unnoticed, however, because meanwhile Hitler had launched his greatest gamble, an attack on Russia. But one aspect of the war to date deserves mention here, before we describe this momentous event. This was the catastrophic effect upon civilians of German methods of waging war.

Sufferings of the Civilian Population

FROM THE start of the conflict, Germany waged "total war." The Nazis discarded all rules and restraints which had been adopted by nations to spare noncombatants, and used every possible measure to create terror and strike down resistance. Widespread and deadly air bombardment made cities and villages theaters of battle, and women, children, and old men became warriors in the defense of their lives, homes, shops, and schools. This distinctive character of the second World War was indicated by an estimate that during the first year and a half, the ratio of civilian to military deaths was 1 to 3, whereas in the first World War the ratio was 1 to 75.

Apart from the loss of human life, the damage inflicted by the war was incalculable. Warsaw, Rotterdam, Belgrade, and many of the other great cities of Europe were left in ruins after the bombers had done their work; fields were trampled under and burned by tanks and bombs; and factories, bridges, railroads, and mines were wrecked or destroyed.

The second World War, more than any previous war, drove great numbers of people from their homes. Even before the war started, refugees had been a problem of international scope. Persecution in Germany, civil war in Spain, and the Japanese invasions of China had driven millions from their native soil and sent them wandering in search of refuge. In Poland, the Netherlands, Belgium, France, Yugoslavia, and Greece the German offensives drove before them floods of refugees and evacuees. When Nazi conquests overtook them, vast numbers were seized and sent to the Reich to do forced labor, together with citizens of the conquered lands.

Refugee movements were not confined to Europe. In China some 30 to 60 millions fled before the Japanese. Later in the war, Japanese invasions were to drive Europeans and many others from Malaya, Burma, and the East Indies. Altogether, an estimated 40 million Europeans and countless Asiatics were torn from their homes by the war. After the war, these tragic victims presented a gigantic problem of repatriation and rehabilitation.

Up to this time, the scourge of total war had afflicted only western Europe and China. Now Hitler extended it over the vast reaches of European Russia by a reckless bid for power and victory.

Hitler's Supreme Gamble—War with Russia

EACH signatory to the nonaggression pact of 1939 between Germany and Russia considered it of temporary value. To Russia it gave time to build defenses against the possibility of a German attack. To Germany it guaranteed peace along its eastern frontiers during the war in the west. But throughout the spring of 1941, signs suggested a breach of the truce.

In March 1941 Russia reprimanded Bulgaria for "extending the war" by permitting German troops to occupy Bulgarian territory. In April it signed a nonaggression pact with the anti-Axis government of Yugoslavia. In May a sensational event foreshadowed a revolutionary change in Nazi foreign policy. Rudolph Hess, the third highest leader in Germany, flew alone to Scotland, allegedly on his own initiative. The British interned him and offered no explanation, but many observers believed that he had brought a proposal for peace between Britain and Germany, preliminary to a war against Russia.

Suddenly, at dawn on June 22, without warning or ultimatum, Germany invaded the Soviet Union. Other nations quickly took sides. Italy, Hungary, Finland, and Rumania immediately declared war on Russia. Great Britain pledged technical and economic assistance to the Soviet Union, and the United States promised material aid. On July 13, the British and Soviet governments concluded a mutual-aid pact in which each agreed not to conclude a separate peace in the war against "Hitlerite Germany."

A Titanic Struggle

The new conflict locked in battle the two largest armies in the world along a front extending 2,000 miles from the White Sea to the Black. Germany struck its heaviest blows on three sectors of this long front: (1) from East Prussia through the Baltic States toward Leningrad; (2) from the northern part of German Poland through White Russia toward Moscow, and (3) from the southern part of German Poland through the Ukraine toward Kiev.

But stiff resistance by the Red army and guerrilla warfare behind the German lines slowed the German drive. Wherever they retreated, moreover, the Rus-

sians pursued a "scorched-earth" policy, destroying crops and factories and everything else that would be of value to the Nazis.

German Advance in Russia Stopped

By the end of November it became clear that the German assault on Russia had reached and passed the peak of its effectiveness for that year. A last tremendous drive on Moscow failed, and early in December the Germans officially admitted that snow and cold weather had stopped their Russian offensive for the winter. Actually their situation was worse, for they had gambled on final victory by winter and had not provided adequate winter equipment or installations. The Russians, on the other hand, were equipped for and hardened to the severe winter weather.

The Russians immediately seized the opportunity to launch a counteroffensive which drove the Germans back from the outskirts of Moscow and Leningrad. The overextended German armies also withdrew slightly from their point of farthest advance at Rostov-on-Don, the gateway to the Caucasus.

Altered Aspect of the War

Hitler's decision to engage a nation as huge and powerful as Russia while still at war with the British Empire astounded the world. Allied strategists interpreted it as a gigantic gamble to break the deadlock in the west. Hitler wanted to seize the oil, wheat, and minerals of western Russia to strengthen the Nazi war machine for the final conquest of Britain.

But the gamble could succeed only if the Nazis won a quick victory over Russia. Failing a quick conquest, Germany would be pitted against an overwhelming combination of Russian land strength, British sea and air power, and American industrial might. Germany had also to contend with conquered but rebellious peoples who eagerly awaited an opportunity to rise against their Nazi masters.

Upsurge of Anti-Nazi Movements

The day the Germans attacked Russia, anti-Nazi activity surged up all over Europe. In addition to Communist sympathizers and the Slavic peoples who felt a racial kinship for Russia, subjugated millions in the occupied countries saw a chance to strike at the Nazis from the rear. A train mysteriously derailed in occupied France; a munitions plant blown up in Yugoslavia—these were typical incidents in the "silent war" carried on in the occupied countries.

The Allies quickly gave inspiration and direction to their partisans. Since the conquest of Poland, representatives of conquered countries had set up headquarters in London. These "governments in exile," through leaflets dropped from British planes in Nazi-held territories and through radio broadcasts, kept alive the hope for liberation. To symbolize defiance of their rulers, the people of the occupied countries caught hold of the British-sponsored campaign to flaunt the letter "V" (for victory) in countless ways that harassed and infuriated the Nazi authorities.

Allied Reaction in the Near East and Africa

In the Near East also the Allies now took vigorous action. Great Britain and Soviet Russia repeatedly warned Iran to expel Nazi agents who had been infiltrating into the country. When these warnings were disregarded, British and Soviet troops invaded the country on August 25 and swiftly occupied it.

On November 18, British armies in Egypt under a new commander, General Auchinleck, struck at the Axis forces in Libya. They hoped to remove the Axis threat to the Suez Canal, relieve the besieged garrison at Tobruk, and divert some Axis strength from Russia. The attack relieved Tobruk December 11 and drove the Axis from Bengasi on Christmas Day. There the British reached the limits of their supply lines, and ceased pressing their advantage.

Japan Prompted to Aggression and War

THE MOST important result of Hitler's attack on Russia was stimulation of Japanese aggression. The first Nazi thrust into Russia led the Japanese to believe that German victory was inevitable, and they started immediately to profit from it. In July 1941 the Vichy government in France responded meekly to pressure by conceding bases in French Indo-China. Japan moved in and massed troops against Thailand.

The Japanese moves drew prompt economic reprisals from the Allies. President Roosevelt "froze" Japan's assets in the United States. Similar action was taken throughout the British Empire. The British and American governments prevailed upon the Netherlands Indies to curtail shipments of oil to Japan.

On Sept. 11, 1941, President Roosevelt ordered the United States Navy to destroy German or Italian raiders that operated in American defense waters. He also negotiated with Japan, seeking a basis for peace in the Pacific. The Japanese protested their desire for peace, but they continued to strengthen their military dispositions at home and abroad.

In October an ardent militarist, Gen. Hideki Tojo, became premier. His first speeches were moderate, and in November he sent a special envoy, Saburo Kurusu, to seek peace with the United States. But this soon proved to have been a trick to throw the United States off guard, pending an attack.

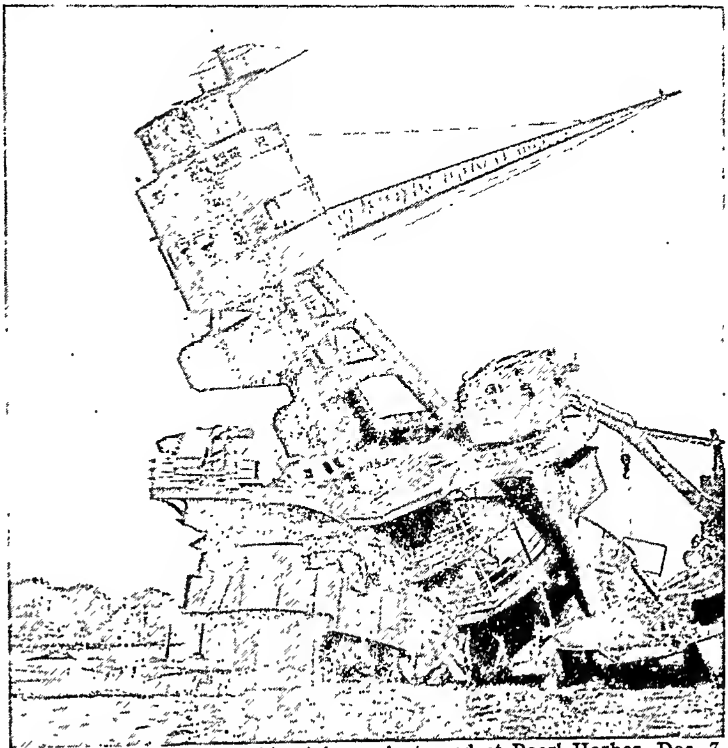
As Japan played for time in which to get its armed forces into position for attack, proposals and counterproposals were exchanged between Washington and Tokyo. On November 26 the American secretary of state Cordell Hull proposed full economic coöperation if Japan would withdraw from China and stop collaborating with the Axis. On December 6 President Roosevelt appealed directly to the Japanese Emperor to intervene on the side of peace.

Early the following afternoon Kurusu, accompanied by the Japanese ambassador, presented Japan's reply to the American proposal. It accused the United States of obstructing the "new order in east Asia" and concluded by saying that further negotiations were useless. Secretary Hull denounced the statement as "falsehoods and distortions." But even as he spoke, Japanese forces were attacking Americans at Pearl Harbor in Hawaii, in the Philippines, and elsewhere.

The United States Goes to War

THE JAPANESE struck without warning. Bombing planes launched at dawn from a carrier ship beyond the horizon appeared over Diamond Head east of Honolulu a few minutes before eight o'clock Sunday morning (1:30 P.M. Washington time), Dec. 7, 1941. They flew across the city seven miles westward to Pearl Harbor and began dropping bombs and launching torpedoes.

The defending forces of both Navy and Army were completely surprised, but went into action immediately. Other Japanese bombers came later, and submarines, large and small, joined in the attack. When the attacks ceased, the battleship *Arizona* had been sunk, the battleship *Oklahoma* had capsized, three destroyers, a target-training ship, and a mine layer had been sunk, and several other ships were more or less heavily damaged. A number of navy and army planes were destroyed on the ground. The Navy lost 2,730 killed, 656 wounded; the Army, 168 killed, 223 wounded. The known Japanese losses were 3 submarines and 41 airplanes.



Wreckage of the battleship *Arizona*, destroyed at Pearl Harbor, Dec. 7, 1941, by the Japanese. The United States Navy published this picture as a reminder to the American people of the score they had to settle.

At the same time and in the same manner, the Japanese attacked Midway Island and struck at the Philippines, British Malaya, Hong Kong, Guam, and Wake (this date was December 8 in the Far East). Meanwhile Japanese troops occupied Siam with the consent of that government.

Two and a half hours after the attack at Pearl Harbor, the Japanese declared war on the United States and Great Britain. On December 8, Prime Minister Churchill announced Britain's declaration of war, and the United States Congress declared that a state of war had existed since the day before.

The success of the Japanese surprise led to controversy and several investigations. The American commanders in Hawaii, Adm. Husband E. Kimmel and Maj. Gen. Walter C. Short, were relieved of their commands. After the war, the public learned that the American intelligence service understood the Japanese radio code and knew that war was imminent, but had not caught any hint of an attack on Hawaii. The commanders protested that they had not received adequate warning; but the high command replied that they should have kept better watch as part of their general duty.

Global Nature of the War

THE JAPANESE attack blacked out the last great area of peace in the world. At one stroke it turned the entire Pacific Ocean into a vast battle zone stretching 12,000 miles from Panama to Singapore, and 9,000 miles from Alaska to Antarctica. This was the greatest war theater in history.

On December 11 Germany and Italy declared war on the United States, and Congress voted declarations in return. Two days earlier China, which had been fighting Japan for four and a half years, issued its first formal war declaration, in which Germany and Italy were now included. During the same week nine Latin American nations declared war on the Axis powers—Costa Rica, Cuba, the Dominican Republic, El Salvador, Guatemala, Honduras, Haiti, Nicaragua, and Panama. The Bolivian government declared war against Japan alone. Most of the other Latin American nations either broke off diplomatic relations with the Axis countries or officially expressed their support of the United States government. By way of reply, the Axis powers forced Bulgaria, Hungary, and Rumania to declare war on the United States. But the Japanese carefully avoided involving Soviet Russia in their Pacific offensive. Russia likewise was just as determined to keep the peace along the common frontier because it needed all its strength to withstand Germany in Europe.

Prime Minister Churchill, accompanied by high British officials, appeared in Washington on December 22 for a historic series of conferences with President Roosevelt and other American military and governmental leaders. On Jan. 1, 1942, 26 nations then at war with the Axis powers joined in a declaration pledging united efforts and no separate peace until victory was achieved. The conference endorsed the eight peace aims drawn up five months previously at the Atlantic conference between Roosevelt and Churchill.

At Rio de Janeiro, on January 28, representatives of the 21 American republics signed an agreement reaffirming their solidarity. The agreement recommended

that the republics which had not already done so should break off diplomatic relations with the Axis powers. All complied except Argentina and Chile. The United States was represented by Undersecretary of State Sumner Welles.

All the important units of fighting power in the world were now engaged. Behind them, on one side or the other, were all the world's resources and technical skill. Now the total power arrayed on each side could be reckoned. And when reckoning was made, there could be no doubt of the final outcome—victory for the Allied powers, provided they could bring their strength to bear before the Axis struck them a mortal blow at some vital spot.

A Year of Standing on the Defensive

AT THE beginning of 1942, the Allied powers faced four major dangers in the war. The first was the Japanese onrush in the Pacific and in Asia, with its threat of overrunning the East Indies, Australia, China, India, and even the west coast of the United States. In Eastern Europe, Russia hung on the edge of destruction, when the Nazi armies resumed their attack in the spring. In North Africa, Axis forces threatened the Suez Canal. Finally, Nazi submarines and airplanes in the Atlantic might succeed in cutting off the flow of American supplies (and now men) to Britain and Africa. The military problem was how to "contain" these threats until Allied strength could be organized to start driving back the Axis forces and destroy their strength and will to fight.

In the Pacific theater, the only source of new strength was the United States—and it could not bring substantial strength to bear west of Hawaii in less than three months because of the vast distances involved. Since the Japanese attack might overrun Malaya and the East Indies in that time, the Allies elected to build up strength in Hawaii and Australia, and start fighting back from these bases. This policy doomed the Philippines, but the loss could not be helped. The Allies hoped, however, that Singapore in Malaya could hold out and provide a check to aggression against the East Indies, Burma, and India.

The issue in Russia could only await the test of battle in early summer. But no such respite could be expected in the Atlantic or in northern Africa, and each threat mounted rapidly to a serious menace. In fact, they were more immediately dangerous than the spectacular sweep of Japanese conquests, because they struck at keystones of Allied strength.

The Battle of the Atlantic

Nazi submarines immediately began reaping a rich harvest of vessels, particularly tankers, off the Atlantic coast of the United States. The United States could ill afford the losses, since the Atlantic states depended upon coastwise shipments of oil from ports on the Gulf of Mexico, and from Venezuela. But the Navy could not provide adequate protection, because its strength was needed in the Pacific.

To move petroleum, the government awarded contracts in July 1942 for the construction of an emergency pipeline from east Texas to Norris City, Ill. Later in 1942 it also authorized construction of a 24-inch pipeline from Texas to New York City and Philadelphia (the "Big Inch" line), and of an additional 20-inch ("Little Big Inch") line. But these lines were not completed until July 1943 and December 1943. For temporary measures the government started drastic gasoline rationing, first in the east and later throughout the rest of the country, and mobilized railroad tank cars for petroleum shipments.

On the high seas, between the United States and Europe, losses had amounted to 3,708,000 tons in 1941. This rate of loss, if continued and intensified, could paralyze the Allied war effort. To meet the danger, the Navy mobilized old destroyers and private yachts, and intensified its efforts to build small Diesel powered sub-chasers and corvettes to supplement larger vessels in protecting convoys. These efforts were pushed by Adm. Ernest J. King, named chief of naval operations March 9. (Adm. Chester W. Nimitz had been given command of the Pacific fleet on Dec. 17, 1941, ten days after Pearl Harbor.)

The Americans and the British also developed long-range airplane cover for convoys, with bases in Scotland, Northern Ireland, Iceland, and Canada. Airplanes based in England also bombed Nazi submarine bases on the European coasts and hunted submarines in all waters around the British Isles. By the middle of 1942, these measures brought losses within tolerable limits.

The Last-Ditch Stand for Egypt

In the Mediterranean area, Axis airplanes had already blocked British use of the Suez Canal, and supplies for the British forces in Egypt, the Near East, and India had to be shipped around Africa. In January 1942, Field Marshal Erwin Rommel started to clinch the Axis position with a new drive to seize the Suez Canal.

After losing Bengasi on January 29, the British held the Nazis in check until May 27. Then a powerful attack engulfed most of the British tank force, took Tobruk June 21, and penetrated Egypt on June 25. On July 1 the British managed to stop the drive at El Alamein, just short of Alexandria. There they held fast on a strip of land between the sea and the impassable Qattera Depression a little inland. Thereafter fighting ceased for the summer.

Japanese Conquest in the Pacific

DURING all these fateful months, the grim struggles on the Atlantic and in Africa were overshadowed by the advances of the Japanese. The grandiose Japanese plan unfolded immediately.

Everywhere in the theater they had air superiority. On Dec. 10, 1941, they used torpedo planes to sink the British battleship *Prince of Wales* and the battle cruiser *Repulse*. Guam fell on December 11, and

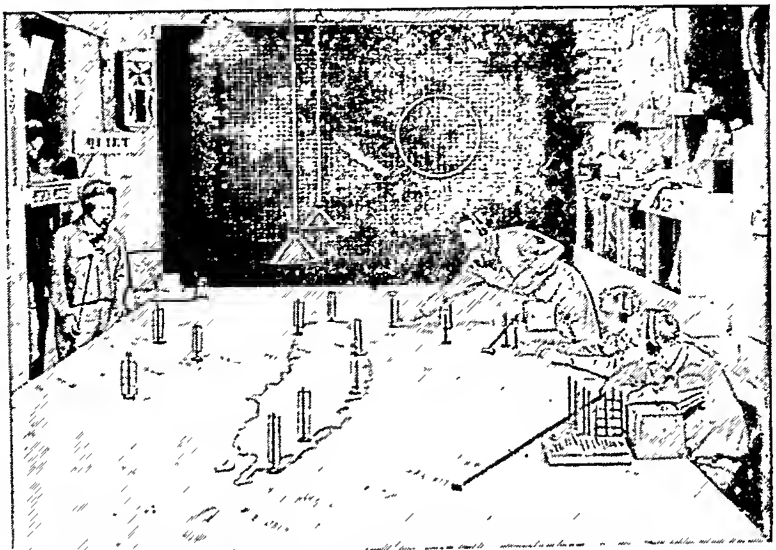
Wake Island, after heroic resistance, on December 23 (*see* Wake Island). The Japanese took Hong Kong on December 25. (Times and dates for the Pacific war are given as of the time zone where the action occurred).

The Magnificent Stand on Bataan

Meanwhile, on December 10, the Japanese launched heavy attacks at Lingayen Gulf and elsewhere on Luzon in the Philippines. The defenders were Filipino reserves and about 3,200 American and Filipino regulars, commanded at first by Gen. Douglas MacArthur and later by Lieut. Gen. Jonathan M. Wainwright. The defenders abandoned most of Luzon, withdrew from Manila Jan. 2, 1942, and concentrated in the rugged peninsula of Bataan. There they kept the Japanese at bay until April 9. The adjoining fortress on Corregidor Island held out until May 6.

This heroic stand engaged forces which otherwise might have pushed through to Australia. It also inspired Australia to demand General MacArthur as supreme commander in the southwest Pacific. President Roosevelt appointed MacArthur to that post, and an airplane landed him in Australia on March 17.

RADAR AT WORK IN THE PACIFIC



Radar was an invaluable aid to the combatants in the second World War. Here radar technicians at an American island headquarters in the Pacific are using radar reports to follow the course of a fight against attacking Japanese planes on a plotting table and the plotting board against the wall.

Loss of Singapore, the Indies, and Burma

Otherwise Allied disaster was complete. In eight weeks, Japanese forces from Thailand drove the British and Australians down the Malay Peninsula to Singapore and took that stronghold on Feb. 15, 1942. Meanwhile the Japanese had overwhelmed Borneo and reached the islands north of Australia. On January 23 and 24, American naval units inflicted loss on the enemy in the Battle of Makassar Strait, but did not delay the Japanese advance. From February 27 to 29, the Allies lost 16 naval vessels under Dutch command in the Java Sea, and the Netherlands Indies fell in March.

The Japanese also lost no time in sweeping the British out of Burma. They took Rangoon March 9, then swept north. Small British and Indian units aided by Chinese troops fought desperately, and the small American Volunteer Group ("Flying Tigers") under Brig. Gen. Claire L. Chennault shot down hundreds of enemy planes. But Mandalay fell on May 1, and retreat became a virtual rout. By May 15, 1942, Burma was in Japanese hands. Conquest was completed by taking the Andaman Islands.

On the other flank of their advance, the Japanese consolidated their positions at Rabaul in New Britain and on the northern coast of New Guinea, and made heavy bombing attacks on Darwin in northern Australia. To distract the Japanese, American naval forces raided enemy strongholds on the Marshall and Gilbert Islands February 1, on Wake Island February 24, and on Marcus Island March 4. On April 18, 1942, army medium bombers, led by Brig. Gen. James H. Doolittle, were taken to within about 800 miles of Japan by the aircraft carrier *Hornet* and bombed Tokyo.

During the first week in May, the United States struck its first real counterblow. From May 4 to 8, American carrier-based planes and army bombers attacked a Japanese invasion fleet in the Coral Sea. The United States lost the carrier *Lexington*, but the Japanese lost more heavily and they turned back.

Battle at Midway Island

A month later the Japanese attempted to thrust east against the United States. Japanese carrier-based planes attacked Dutch Harbor in the Aleutian Islands, and landing forces occupied Attu, Agattu, and Kiska islands. A strong invasion force moved directly against the Hawaiian Islands.

On June 3, American carrier-based planes from a naval squadron joined land-based planes from Midway Island in a four-day battle against the invaders. The Americans lost the carrier *Yorktown*, a destroyer, and 150 planes. But the invaders were utterly crushed, with a loss of four aircraft carriers, two heavy cruisers, three destroyers, and 275 planes.

This was the last serious aggressive effort of the Japanese. Within two months, American counterattacks started to force back the conquerors. But many months were to pass before the United States could build up a powerful attack. Meanwhile one of the supreme issues of the war was being fought in Russia.

The Russian Theater of War in 1942

In the winter of 1941–42 the Red army's counteroffensive carried the Russians back to the main German centers of resistance. By spring the Red army had regained one-sixth of the territory it had lost. Then warmer weather brought a renewed German assault.

This time the drive was two-pronged. One spearhead was aimed at Sevastopol on the Black Sea, which fell July 1, 1942. The other was launched at the Cau-

casus oil fields. The drive pushed through Rostov-on-Don on July 27, Maikop on August 9, and the naval base at Novorossisk on the Black Sea, September 11. The Red army stopped the drive just short of Grozny, within a hundred miles of the Caspian Sea.

In the north the Russians also held the Germans around Voronezh; so, in an effort to cut through and divide the Russians, the Germans attacked on August 24 to cross the Volga River at Stalingrad. There, however, they finally met disaster.

The Russian Stand at Stalingrad

The battered Red army determined to die to the last man in the streets of Stalingrad before allowing the city to fall into Nazi hands. In the face of such stubborn resistance—a house-to-house resistance that frequently limited a day's gains or losses to only a few yards—German striking power spent itself. Despite desperate urging from Hitler, the Germans could not break through, and gradually sheer exhaustion brought an end to the ferocious effort. As autumn wore on toward winter, and good fighting weather for the Russians, the world realized that the supreme German bid for victory had failed.

Thus by late autumn in 1942, the Allies had won their first objectives. They had reduced submarine attacks in the Atlantic and stopped the Axis drives in Africa, the Pacific, and in Russia. Meanwhile as told elsewhere (*see* Roosevelt, Franklin D.), the United States had been marshalling men and equipment for the next phase, the launching of a powerful counterattack. Now the Allied forces began reaping the first fruits of that intensive effort.

World-wide Counterattack against the Axis

THE FIRST true counterattack came Aug. 7, 1942, when United States marines struck in the Solomon Islands. A month later American and Australian forces started to drive the Japanese out of Papua in New Guinea. In November the British routed the Axis in Egypt, and in the same month, American and French forces seized French North Africa. In December, the Russians counterattacked on their front.

One year later, the Germans and Japanese were on the defensive everywhere and Italy was knocked out of the war. The Mediterranean was free of Axis menace. The Russians stood close to the German borders, and Allied aviators were masters of the air over western Europe. The momentous actions which accomplished all this can best be traced by theaters of war.

Counterattack in the Southwest Pacific

BY THIS time the Americans had learned to appreciate air power and made it the key to all offensive actions at sea as well as on land. They knew also that revolutionary methods and equipment would be needed to keep air, land, and sea forces operating at all times over vast areas distant from supply bases. Most important of all, they realized the need for *unified command*—one man on the spot in each operation with full authority over all the forces involved. Therefore each operation was undertaken by a *task force*, made up of Navy and Army elements and commanded by a Navy or Army officer, according to which service seemed to have the key rôle. In the Pacific theater, overall command was exercised by Admiral Nimitz in the "island steppingstones to Japan" north of the equator, and by General MacArthur along the island chain from Australia to Japan.

The Fight for Guadalcanal

The new methods received their first tryout in the attack in the Solomon Islands. The 1st Division of Marines landed August 7 at Tulagi harbor and on Guadalcanal to seize the airfield (later called Henderson Field). Two nights after the Guadalcanal landings, the Japanese navy struck at the U. S. Fleet screening the operations at Savo Island. The Navy retaliated on Aug. 23–25, Oct. 11–12, Oct. 26, and Nov. 13–15, 1942, and destroyed a large portion of the enemy fleet. Later the 2d Marine Division, the Army Americal Division, and other Army infantry elements were added to the attack. Holding the island during six months of bloody jungle warfare, they wiped out the last enemy units on Feb. 8, 1943.

In September, American and Australian ground and air forces struck back at the Japanese in Papua, the southeastern portion of New Guinea. Through jungle, swamps, and the nearly impassable Owen Stanley Mountains, the battle raged for six months. On Jan. 22, 1943, the Allies took Sanananda, thereby lifting the threat of a Japanese invasion of Australia.

On March 2, Allied land-based planes sighted and attacked an enemy troop convoy in the Bismarck Sea. The entire convoy of ten Japanese cruisers and destroyers and twelve transports was destroyed with a loss of 15,000 men. And 82 Japanese planes were shot down at the cost of only four American planes.

For the rest of the spring and all summer, General MacArthur and the southwest Pacific naval commander, Adm. W. F. ("Bull") Halsey, worked closely together in driving the Japanese out of eastern New Guinea, the Solomons, and the Bismarck Archipelago. On June 30, Allied land, air, and naval forces attacked the Japanese on Rendova Island in the Solomons. On July 2–3 the Allies attacked New Georgia Island. Then on July 6 American naval vessels sank six enemy ships and damaged four others in the Kula Gulf north of New Georgia, with loss of one United States cruiser. On August 5, American forces took the airfield at Munda on New Georgia. The Navy won another victory in the Vella Gulf August 6 and 7.

Meanwhile, American and Australian land forces pressed forward against Salamaua on New Guinea. On September 5, American paratroops encircled 20,000 Japanese near Salamaua. The Allies took Salamaua on September 11, and Lae five days later. On September 22,

MacArthur's troops landed by sea and air near Finschhafen. After a ten-day siege, Australian troops captured the base October 2.

Nine days later, American troops occupied Vila, Japanese air base on Kolombangara Island, west of New Georgia. On November 1, Marines under General MacArthur's command invaded Bougainville Island, the westernmost of the Solomon group, and wrested it from 45,000 Japanese.

Meanwhile the Americans had cleaned out the enemy occupation forces in the Aleutians. On May 11 the Army bypassed Kiska Island and landed on Attu. After 12 days of desperate resistance, most of the defenders launched a suicidal counterattack and were killed. The rest committed suicide, and the seizure was complete May 30. On August 15 American and Canadian troops assaulted Kiska, only to find that the Japanese had fled under cover of heavy fog.

The Marine Action at Tarawa

Allied strategy had cleared an outer ring of positions covering Australia. Admiral Nimitz now attacked to screen the sea route from Hawaii to Australia. On Nov. 21, 1943, a Marine-Army force under his command invaded the Gilbert Islands. A combat team of the 27th Infantry Division landed on Makin while the 2d Marine Division stormed ashore on Tarawa. Makin was not heavily defended; but Tarawa fell only after a savage battle. The capture of the island cost the Marine Corps 913 men killed and 2,000 wounded.

THE HEROIC STORMING OF TARAWA

These American Marines have just established a beachhead on the small island of the Gilbert group. They are now going over the top of a log barricade in the face of withering fire to storm the Japanese airfield. The three-day battle on Tarawa was one of the hardest and bloodiest in Marine Corps history.

In the Southwest Pacific, MacArthur's troops moved to win control of Vitiaz and Dampier straits between New Britain and New Guinea. On December 15 an army force landed at Arawe near the southwestern tip of New Britain. Eleven days later the 1st Marine Division landed farther to the west at Cape Gloucester. This maneuver completed a tight protective screen for Australia and helped neutralize the Japanese stronghold at Rabaul in northern New Britain.

During all this time, American submarines, operating independently of the fleets, waged intensive war against Japanese shipping. They hunted along the supply routes between Japan and its possessions and even cruised into Tokyo Bay. Their attacks came close to destroying the Japanese merchant marine.

Counterattack in North Africa

DURING these same months of 1943, counterattack had started on the other side of the world against the Axis forces in North Africa.

Throughout the summer of 1942, the Allies had struggled to resupply the British 8th Army in Egypt with emphasis on American tanks and aircraft. On August 18, Gen. Harold Alexander took command in the theater and Gen. Bernard L. Montgomery was named field commander. On October 23, the British started a devastating assault from El Alamein. Infantry, operating mostly at night, cleared a path for tanks through the enemy mine fields, and a furious action routed Rommel's tank force. Abandoning six Italian divisions to their fate, the Germans fled westward, harried by Allied air power. By November 6 the British had driven the fleeing Germans from Egypt. They maintained a relentless 1,300-mile pursuit along the shores of Libya, and swept victoriously into the Axis seaport of Tripoli, Jan. 23, 1943. Rommel's weary forces found refuge behind the fortified Mareth Line in southern Tunisia.

Americans Invade North Africa

Meanwhile, in the early morning of Nov. 8, 1942, powerful American forces under the command of Lieut. Gen. Dwight D. Eisenhower had landed at numerous points on the Mediterranean and Atlantic coasts of French North Africa. They captured the strategic points in Algeria and Morocco in a few days, and were reinforced by the British First Army.

The attack was denounced by the Vichy government, and the Nazis promptly occupied all of France. But naval personnel at Toulon kept the French fleet there from German use by scuttling it November 27. Meanwhile the Allies had captured the commander of the French Navy, Admiral Darlan, November 10, in Algiers. On November 15 he proclaimed collaboration with the Allies and named Gen. Henri Giraud commander of French forces. The French in Africa then ended all resistance. Since Darlan had previously collaborated with the Germans, protest arose against this policy; but it ceased when Darlan was assassinated by a French youth December 24.

The next task was the capture of the remaining Axis strongholds in Tunisia. Germans under the command of Col. Gen. Jurgen von Arnim held the towns of Bizerte and Tunis. About 200 miles to the south, Rommel crouched behind the Mareth Line. In between stretched a 75-mile-wide strip of rugged terrain strongly held by Axis troops. On Feb. 6, 1943, Eisenhower was appointed commander in chief of all United Nations' forces in North Africa with the rank of general and given the mission of freeing North Africa from the enemy.

The Germans took the offensive briefly in Tunisia in a fierce tank battle for the strategic Kasserine Pass from February 14 to 25. The Allies finally won the pass; then from the west and south they pushed Rommel's *Afrika Korps* northward. On March 29 Montgomery's troops flanked the Mareth Line and captured the German supply ports of Gabes, Sfax, and Sousse. By mid-April the Germans held precarious possession of only two remaining strongholds, Tunis and Bizerte. On May 2, the Allies took the key defensive position, Hill 609, near Mateur. On May 7 the Americans took Bizerte and the British entered Tunis. On May 12 General von Arnim surrendered his 200,000 troops.

The Allies Overrun Sicily

Allied aircraft immediately began a devastating bombardment of the Italian islands, Pantelleria, Lampedusa, and Linosa, off the Tunisian coast. The battered garrisons surrendered in June.

The surrender cleared the way for the invasion of Sicily. On July 10 the assault was delivered by a 2,000-ship invasion fleet under command of General Eisenhower with British General Alexander as his deputy. Preceded by paratroops and glider-borne troops, Americans landed near Gela on the southern shore, and British and Canadians landed near Syracuse on the eastern coast. The American troops, commanded by Lieut. Gen. George S. Patton, Jr., fanned out to the west with their armored forces in the vanguard. The British and Canadians under General Montgomery captured Syracuse, then struck north toward the important port of Catania. Five weeks of desperate fighting ended in the fall of Messina in the northeast corner of the island on August 17.

Mussolini Quits as Italian Leader

On July 25, in the midst of the Allies' conquest of Sicily, Benito Mussolini was forced to resign as premier of Italy. King Victor Emmanuel appointed Marshal Pietro Badoglio to succeed Mussolini as premier.

After the last Axis troops had fled across the Strait of Messina, a huge Allied air armada slashed at southern Italy's railway and communication system in order to disrupt the enemy's mainland defenses. The principal target was Foggia, key rail point about 20 miles inland from Naples. A massive raid on Foggia August 19 opened an Allied air barrage against military objectives up and down the entire length of Italy.

Allies Storm the Italian "Boot"

Then early in the morning of September 3, the British 8th Army stormed across the Strait of Messina and landed in southern Italy. In the face of the powerful Allied assault, Premier Badoglio's government surrendered its armed forces unconditionally September 8. This knocked the Italians out of the war as active partners of Germany, but the Germans continued to fight. On September 9, the American 5th Army, commanded by Lieut. Gen. Mark W. Clark, seized a beachhead near Salerno, a few miles southeast of Naples. Simultaneously the British mopped up the southern end of the Italian peninsula by capturing the Taranto naval base September 9, and the Adriatic port of Brindisi two days later. Then they struck north, and on September 16, the British 8th Army joined the American 5th at Salerno.

The Foggia air base fell to the Allies on September 27, and on October 1, American and British armored columns moved into the burning city of Naples while the Germans scurried northward to take up new positions along the Volturno River. By October 18 the relentless Allied drive forced the enemy from their Volturno defense line, and a new battle line was formed across the entire peninsula.

The new German positions lay in mountainous country. The key position in the west ran north from the sea along the Garigliano River, and up a small tributary, the Rapido, to the town of Cassino. There a dominating hill was crowned by the monastery of the Benedictine order, one of the oldest monastic establishments in western Europe. The Germans knew the Allies would spare this venerable monument if they could, and used it as a stronghold.

By now, bitter winter weather and deep mud and snow made ground operations almost impossible. The attack bogged down for the winter into a grueling siegelike gnawing at the German positions, particularly around Cassino. But the Allies had gained an enormous strategic advantage.

Allied air power now dominated the entire Mediterranean, and the Axis could no longer block the shipping lanes between Gibraltar, the Suez Canal, and the Near East. This gain eliminated the lengthy haul around Africa and gave the Allies the equivalent of thousands of new ships for building up their attacks throughout the world. From air bases in southern Italy, long range bombers could reach targets in southern Germany and the entire Danube basin. And German ground strength was taxed by imperative need to screen southern Germany from invasion.

Russian Counterattack in 1943

THROUGHOUT 1943 the Russians had been making even more impressive progress on their front. Their counterattacks began as soon as winter came in November 1942, and developed full power by the end of the year.

On November 19, the Russians started attacking the German flanks at Stalingrad. The pincers closed on New Year's Day 1943, making the besiegers the besieged. The entrapped force resisted until Field Marshal Gen. Frederick von Paulus surrendered the remnants January 31. The surrender was complete February 2. This disaster cost the Germans about

HOW THE NAZIS WERE FORCED BACK—1942-45

November 8, 1942

May 12, 1943

June 6, 1944

August 15, 1944

January 1, 1945

May 8, 1945 (*V-E Day*)

These Maps Show How the Spread of German Conquest, Illustrated on Page 256, Shrank under the Blows of Allied Arms

330,000 men killed or captured. The Germans in the Caucasus area fled, but many were cut off when the Russians took Rostov-on-Don, Kursk, and Kharkov, the fourth largest Russian city, in February.

Struggles on the Central Front

On the central front, the Russians started grinding forward in December. Their grand objective was Smolensk; but they were stopped a hundred miles east of that point, after a winter of fighting, by stiff German resistance and springtime mud. In the south, German reserves drove the overextended Russians back 100 miles, and retook Kharkov on March 14.

On July 5 the Germans started an attack in the Orel-Kursk-Belgorod sector. Ten days later the Russians counterattacked, taking Orel and Belgorod August 5. Then they drove a 43-mile-wide spearhead into the Ukraine, and outflanked the Germans in Kharkov. After a bitter street-to-street fight, they took the city August 23.

Next the Russians attacked the Donets River basin in the south, and the Bryansk-Smolensk sector of the central front. Another drive reached the Azov seacoast and took Taganrog August 31. On September 16 the Russians took the naval base at Novorossisk on the Black Sea.

The Reds Reach the Polish Border

Meanwhile on September 8 the Red army had taken the rail center of Stalino, routing the Germans in the Donets salient. On the central front they seized Konotop, another rail junction, September 7. Bryansk fell on September 17, and on the 25th the Germans evacuated Smolensk.

Next the Russians broke through the German defense line along the Dnieper River and rolled forward to engulf Kiev November 6. On November 26 they took Gomel, and pressed on to capture the rail center of Zhitomir Jan. 1, 1944. Three days later they crossed the 1939 Polish border. Thus in 1943 they freed a large part of their national territory.

At Sea and in the Air

WHILE these titanic struggles on land were going on, the western Allies strove to win mastery on the sea and in the air. The sea struggle flared up again early in 1943, when the Germans tried to weaken the ever-mounting Allied assaults by increasing submarine attacks against shipping in the north Atlantic.

The Battle of the Atlantic

In their new effort the Germans kept 500 to 700 submarines prowling the sea lanes in "wolf packs," saturating convoys with torpedoes. About 700 merchant ships fell victim before the Allies developed two effective defenses against the undersea attacks. First, they bombed German submarine bases incessantly. Second, they convoyed ships with long-range bombing planes from bases on either side of the ocean. Later they added "baby" escort carriers, made over from merchant ships. Radar and other detecting devices also helped. By midsummer the Allies gained the upper hand and not a single Allied vessel was sunk in the North Atlantic during the four months ending September 18.

Then the Germans made a final attempt with Hitler's last reserve of 150 to 200 submarines. The Germans used a "homing" or acoustic torpedo which was drawn to the screws of a ship. They also equipped their submarines with heavy antiaircraft guns to fight Allied planes, and German planes launched radio-controlled bombs against Allied surface vessels. The Allies met the revived German attack with more "killer groups" of bombers and more fast surface craft. By the end of the year the Allies had almost eliminated the submarine menace in the Atlantic.

U. S. LEND-LEASE AID
Final Figures

British Empire	$31,390,000,000
Soviet Russia	11,100,000,000
France	3,230,000,000
China	1,557,399,993
American republics	495,410,240
Netherlands	230,127,717
Greece	75,475,880
Belgium	148,394,457
Norway	51,524,124
Turkey	26,026,355
Yugoslavia	32,026,355
Other countries	24,787,879
Aid not charged to foreign governments	2,578,827,000
Total	$50,940,000,000

REVERSE LEND-LEASE AID
Final Figures

United Kingdom	$5,072,102,000
Australia	835,004,000
New Zealand	204,566,000
India	639,443,000
Union of South Africa	885,000
France	795,471,000
French Africa	70,358,000
French New Caledonia	1,171,000
Belgium	191,033,983
Belgian Congo	182,000
Netherlands	1,450,699
Dutch Curaçao and Surinam	917,000
China	3,672,000
Soviet Russia	2,210,000
Total	$7,818,465,682

This table shows the amount of lend-lease aid given by the United States to "Allied" countries during the second World War, and the amount received in return.

A vital part of the struggle was the "Murmansk run," around the north end of Norway to Russia's northern ports. German submarines and airplanes menaced the convoys all the way. Not until late in the war was the run made fairly safe.

War in the Air

Once the Germans had introduced the deadly method of *strategic bombing* deep in enemy territory, Britain and the United States worked to turn this strategy against the Nazis. To do so they developed fighter craft which could drive the German air force (*Luftwaffe*) from the air, and long-range bombers which could make round trips over Germany with heavy bomb loads.

In 1940, the Hurricane and Spitfire, fighters of the British Royal Air Force (R.A.F.), proved superior

to German fighters. The first American designs were not as effective, but the later Lightning (P-38), Thunderbolt (P-47), and Mustang (P-51) met all requirements. The problem was to get these planes in ample numbers, and this was accomplished in 1943.

For bombers, the British developed "night" craft which could carry 1-ton and 2-ton "blockbuster" bombs, but relied upon darkness rather than fighting power to escape destruction. The Americans produced two heavily-armed "daylight" bombers, the Flying Fortress (B-17) and the Liberator (B-24). By flying in large numbers and tight formations, they could ward off attacks by the existing types of German fighters.

The Americans also developed air transport on a world-wide scale. By the end of the war, the United States Army Air Transport Command with 2,700 planes was flying a global network of 188,000 miles of routes. The Navy flew 420 planes over 65,000 miles of routes. A particularly arduous task was flying the "hump" of the Himalayas, transporting supplies from India to China. This was done by units of the 10th Air Force.

Bombing War against Germany

The British made token raids against Germany early in the war, and on Aug. 25, 1940, they raided Berlin. On May 30, 1942, they shattered Cologne with their first 1,000-plane raid. Late in 1942 the Americans joined the R.A.F. in strategic forays over the continent, and strategic bombing increased steadily.

Single raids frequently dropped more than 1,000 tons of bombs. In all, 2,697,473 tons of bombs were dropped on Nazi-held Europe. Of the entire tonnage, 32.1 per cent was dropped on transportation targets, and 9.3 per cent on oil, chemical, and rubber factories. On May 17 the British bombed out the key dams in the Ruhr Valley. On August 1, 178 American planes flew a 2,400-mile round trip from Africa to blast the Ploesti oil fields in Rumania, but suffered heavy loss in doing so. American planes made their first shuttle raid on August 17, flying from England to bomb a target deep in Germany, then landing in Africa.

Air-borne Combat Troops

By 1943, the Allies were profiting from another German innovation—carrying troops by air to make attacks. Paratroops were used extensively. They were carried by large transports (Commandos or C-47's, in the American service), and the troops descended by parachute upon their objective.

In addition to paratroops, the Allies carried air-borne troops in transports or in gliders. Some carriers could take jeeps and light tanks or cannon. In all, the United States had 5 divisions of air-borne troops.

Closing in on Japan and Germany

THE GAINS of 1943 placed the United States, Britain, and their Allies in position to close in on the Germans and Japanese, and deal death blows to the two powers. The campaign against the Japanese was made difficult by the vast distances to be traversed, but far greater strength would be needed to defeat Germany. The proportional effort needed is plain from the ultimate deployment of forces against the two foes. In the Pacific, the United States used the larger part of its naval power, 6 divisions of Marines, and 21 Army divisions. For the final invasion, 11 additional divisions would have been deployed from Europe. The United States was aided by 6 divisions of Australian troops. A large number of Japanese divisions were tied up in China and more were kept on guard in Manchuria against a Russian attack.

Against Germany, the United States employed 68 Army divisions. Allied with them were 306,000 British and dominion troops, and an estimated 5,000,000 Russians. In addition, considerable Nazi forces were needed to keep conquered populations in order.

Advance in the Pacific

STRATEGY of the attack in the Pacific was simple in principle. As an island land, poor in resources, Japan was utterly dependent upon imports. Once American air and naval power could get close enough to set up a blockade, they could strangle Japan.

The task lay in overcoming the obstacles presented by vast distances in the Pacific. Under all older standards of warfare, a fleet could not carry fuel and supplies enough to fight more than 2,500 miles from a base. Long-range bombers such as B-17's and B-24's could make round trips of no more than 3,500 miles. Invasion troops needed a steady stream of food, ammunition, and replacements. These supplies and men had to be readily available at near-by bases.

A "Steppingstone" Approach by Giant Strides

The Americans met these difficulties by seizing base after base for use as "steppingstones." In 1944, Admiral Nimitz's forces advanced more than 2,000 miles from Hawaii to seize Kwajalein atoll (February 5) and Eniwetok (February 22) in the Marshall Islands. The next blow, about 1,200 miles from Eniwetok, struck the Marianas. Saipan was taken June 15–July 9, Tinian July 24–August 1, and Guam July 21–August 10. The Japanese navy and air force made only one major attempt to break up the American drive, west of the Palaus, on June 19–20. Adm. Mark Mitscher's Task Force 58, with 15 carriers, destroyed 700 Japanese airplanes and 30 ships at a cost of more than 100 American planes.

On June 16, new, long-range Superfortress (B-29) bombers had started attacking Japan from bases in China. The Marianas provided a better base, and raids were intensified. They were also as close to Japan as the Philippines or the parts of China accessible to the Americans. But they were not large enough to serve as bases for invading Japan. For this purpose, the Philippines were needed.

Nimitz's forces prepared for the seizure of the Philippines by invading the Palau Islands September 15. Most of the resistance encountered was on Peleliu Island. where fighting continued into October. During

all this advance, long-range bombing attacks kept Japanese strongholds on Jaluit, Ponape, and Truk neutralized.

Meanwhile, MacArthur's forces were advancing upon the Philippines by shorter steps. They took the Admiralty Islands by March 20, Hollandia on New Guinea April 22–28, Biak and Noemfor northwest of New Guinea, on June 28 and July 6, and Morotai in the Halmahera Islands on September 15. All these islands were within easy striking distance of the Philippines.

Invading the Philippines

Almost immediately the Americans brought the long double advance to a strategic climax by invading the Philippines. To prepare the way, Admirals Halsey and Mitscher led sweeping naval and air forays throughout the area, destroying more than 1,000 Japanese planes and some 160 ships. Then on Oct. 20, 1944, the invasion struck Leyte Island.

The invaders landed easily, but it soon became plain that the Japanese would stake everything upon this fight. Two Japanese fleets tried to break up the attack and were shattered October 23–26. North and south of Leyte, the Japanese commander, General Yamashita, continued to pour in reinforcements by ship. But the attackers inched forward through rain-drenched, forested mountains, until the conquest was complete about Christmas Day, 1944.

Campaigns in China and Burma

Meanwhile the Japanese had tried to cripple B-29 bombing from China by taking the bases. By October they had succeeded, and the Americans were forced back to western China. But a strong counter to this attack was developing in Burma.

In 1943 the Allies started to build a Ledo road from Assam in India to link up with the old Burma road. Early in 1944 the Japanese tried to block the effort by an offensive against Imphal. The attack was stopped, and early in March the Allies started an air-borne assault. Maj. Gen. Orde Wingate led British Chindits, and Brig. Gen. Frank Merrill led American Marauders. The invaders took Myitkyina airfield May 17 and the town August 3. This cleared the way for use of the Ledo road.

Russians Drive Ahead in 1944

THROUGHOUT the early months of 1944, the principal pressure upon the German armies was maintained by the Russians. On January 19 they launched a powerful drive from the vicinity of Leningrad and Lake Ilmen that carried to the Baltic states by spring. In the southwest they drove into the Ukraine with equal power. On February 22 they broke the German lines by taking the important iron center of Krivoi Rog. This opened the way to recapture of Odessa April 10. Five days later, the Red assault swept over the Crimean Peninsula and pinned the Germans in Sevastopol. A bitter 24-day siege took this key city May 9.

The Russians now ended all menace from Finland by taking Vyborg on the Karelian Isthmus June 21. They turned next against the Polish front, taking Minsk, Grodno, and Pinsk. On July 24 they took the Polish rail center, Lublin. A crushing Russian offensive forced Rumania to ask for peace and declare war on Germany August 24. Rumanian troops held the capital, Bucharest, until the Russians arrived August 31.

Now the Germans had to withdraw from the Balkans before they were cut off. The Russians disposed of Bulgaria summarily by invading September 8. Bulgaria then declared war on Germany as the price of peace; and on the 9th Russia announced the end of the campaign. Previously, Russian troops had reached the border of Greece; but by agreement, expulsion of the remaining Germans was left to the British. British air-borne troops dropped on Cape Araxos September 23, and two days later ground troops went ashore. Almost immediately the Greeks fell into

RUSSIANS SMASH INTO CENTRAL EUROPE

Starting from the battle line that had reached Moscow and Stalingrad, the Russians launched a counterdrive that pushed the Germans back during 1943 and 1944. Early in 1945, Soviet troops captured Warsaw.

internal dissensions almost as bitter as the struggles of the war (*see* Greece).

Meanwhile, the Russians had plunged into Yugoslavia on September 8 to unite with Yugoslav Partisan forces under Marshal Tito. On September 28 a Soviet force entered eastern Czechoslovakia. On October 16, combined Russian-Partisan armies fought their way into Belgrade, the Yugoslav capital, and captured it October 20.

On the northern front also the Russians had opened an attack on the Baltic States. On September 22 the Soviets captured the Esthonian capital and naval base of Tallinn. A week later all Esthonia was in Russian hands; and by the end of October the Russians had captured all Lithuania and almost all Latvia. In the south they pressed on into Hungary and late in December laid siege to Budapest, the capital.

Thus the year ended with the Germans driven virtually within their borders, and compelled to wait for the deathblow. Meantime on the western front, American and British forces had rendered Nazi power as ineffectual.

Closing in on Germany in the West

AFTER winter brought the bitter Italian campaign to a virtual stalemate, the western Allies faced the problem of where to strike in 1944. British Prime Minister Churchill was all for continuing the drive from the Mediterranean against what he had called "the soft underbelly" of the Axis. Such an attack, if successful, might have forestalled Russia's conquest and dominance in the Balkans.

The Americans objected because the proposed theater was mountainous and easily defended. They preferred the shorter route from the English Channel across northern France and Belgium, straight to the industrial heart of Germany in the coal-and-iron region of the Ruhr. The Russians also preferred this more northernly "second front," for it would draw off the greatest number of Germans from Russia. In a conference at Tehran (Nov. 28—Dec. 1, 1943), Roosevelt, Churchill, and Stalin chose this western attack and fixed the time as not later than June 1944.

The Italian Campaign in 1944

WHILE preparations for the western invasion of Europe went forward, the Allied forces in Italy moved to break their stalemated campaign, under new commanders. Following the Tehran Conference, General Eisenhower was named supreme Allied commander in western Europe, and his former deputy, British General Alexander, was made commander of the Allied forces in Italy. British Gen. Sir Henry Maitland Wilson was put in supreme command in the Mediterranean.

In the hope of weakening the German position at Cassino, the new command landed an invasion force January 22 at Anzio, behind the Nazi defense line and only 28 miles south of Rome. The Germans were surprised but they rallied quickly and kept the Allies pinned down to the beachhead.

To draw the Germans away from Anzio, General Alexander had ordered an American attack along the Rapido River (January 20). The attack proved a costly failure and produced vehement criticism after the war from adherents of the troops engaged. Winter attacks upon Cassino itself proved equally futile. On February 15 the Allies reluctantly shattered the monastery by air bombardment; but this did not help.

Liberation of Rome

By spring the campaign looked hopeless. But on May 11 a heavy attack broke through south of Cassino. The attackers joined up with the forces at Anzio and swept on to take Rome June 4.

Two days later, the Allies invaded France, and the Italian campaign became a "containing" operation to keep German troops diverted from the main theater of war. Allied troop strength was held at about 20 divisions, and with this force the Allies pressed upon the German defense line.

The line started at Livorno on the west, passed a little south of Florence, and ran through mountainous country to Ancona on the east. The Allies took Livorno and Ancona July 19, and entered Pisa near Florence July 23. A month later (August 22) the Germans abandoned Florence to avoid an impending assault, and retreated to their Gothic line in mountainous terrain south of the Po Valley. On September 5, the Americans cleared Pisa. On September 25, British and Canadian troops took Rimini, and on December 5 the Canadians took Ravenna. But the Allies did not rout their foes until German power failed utterly the next spring.

D-Day Brings Invasion of Western Europe

THE PROPOSED attack in western Europe could be delivered most directly through the Pasde Calais region opposite southeastern England. But the Germans expected attack here and had fortified the region. The Allies therefore decided to make their attack over the beaches of Normandy, east of the Cotentin peninsula.

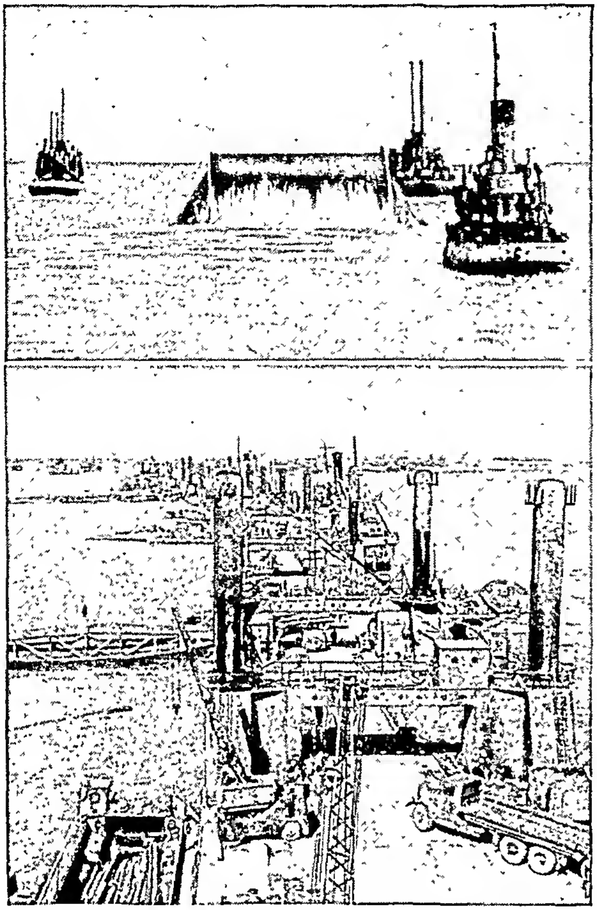
Bitter experience indicated that the invasion would be difficult. Specially trained British commando units had made quick raids on coastal points without undue loss. But a trial raid on a large scale at Dieppe Aug. 19, 1942, had cost 3,500 killed, wounded, or taken prisoner out of 6,000 engaged (principally Canadians).

Now the high command packed the British Isles with troops, planes, and military equipment. Feints were made at Holland and other points to mislead the Germans. An elaborate array of false equipment, such as tanks, was made of rubber to be inflated just before the attack and placed in false locations for deceiving Nazi aviators. Artificial harbors were prepared for temporary use off the beaches.

Successful Landings on D-Day

For some weeks beforehand, Allied planes poured thousands of tons of bombs on German airdromes, coastal defenses, and supporting railways and roads. Then in the early morning of June 6 an invasion fleet

SUPPLYING THE INVASION OF FRANCE



After the beachheads were won in Normandy, the Allies had to keep their forces supplied for the push inland. (Top) A huge floating reel lays a gasoline pipe line across the English Channel. (Bottom) A British "portable port" of steel barges provides a breakwater and wharf for landing supplies.

of some 4,000 ships landed American and British divisions on Normandy beaches. Air-borne divisions dropped behind the German lines. In the first week, the Allies established beachheads between Cherbourg and the city of Caen along a 60-mile-wide strip, and within a week they drove about 20 miles inland. Casualties for the landing were about 40,000 out of some 600,000 engaged.

The Americans strove first to take the port of Cherbourg and succeeded on June 25. Meanwhile British and Canadian forces pushed against Caen and captured the city July 9. On July 25 the American 1st Army broke out of the beachhead at St. Lô. Following the break-through, armored columns of the American 3d Army, commanded by Gen. George S. Patton, Jr., swept through Rennes on August 4 and Chartres on August 17. The Germans counterattacked, but Americans and Canadians quickly sealed them in a trap by joining behind them near Falaise. The maneuver also opened the roads to Paris. On August 25, American troops helped the city's inhabitants force the German garrison to surrender.

Ten days earlier the American 7th Army, with British and French contingents, had landed on the Mediterranean coast of France. It quickly routed or captured most of the Germans in the region and drove north, joining the 3d Army near Dijon September 11.

Germans Hurl Flying Bombs

As the Germans suffered mounting reverses on all fronts, they made increasing use of "vengeance" weapons. These were flying robot bombs, launched from bases in France against southern England. The "V-bombs" injured and killed thousands of English civilians and caused great property damage.

In an effort to wipe out the enemy launching positions on the "rocket coast," the British and Canadians pushed northeast toward Belgium and the Netherlands. On their right, the American 1st Army, under Gen. Courtney H. Hodges, moved across Belgium toward the German frontier at Aachen. Antwerp fell to the Allies September 4, and Liége September 8. General Patton's 3d Army pushed east from Paris, taking Verdun August 31, until it met strong resistance along the Moselle River. On its right, the 7th Army under Gen. Alexander M. Patch pushed through the Rhone Valley to Lyons.

A Final Strong German Stand

The sensational sweep through France and Belgium raised hopes of victory before winter; but now the Germans rallied. One force held stubbornly to the mouths of the Scheldt River, preventing use of Antwerp. A strong line held the lower Rhine across the Netherlands and the German frontier from Nijmegen and Aachen southward to the Ardennes and east along the old Franco-German border to the Rhine.

In an attempt to break this line, American and British air-borne troops were dropped September 17 at Nijmegen and Arnhem in the Netherlands. The Allies took the bridge at Nijmegen; but at Arnhem the Germans smashed the attack and forced the remnants of the British troops to surrender September 26. The American 1st Army entered Aachen October 11, but was stopped at the Roer River to the east. Patton's 3d Army was unable to capture Metz until November 22. The Canadians suffered 30,000 casualties before they cleared the mouths of the Scheldt on November 9.

The "Battle of the Bulge"

As the cold, wet season advanced, the Allied drive into Germany slowed down. The Germans chose an opportune moment to launch a surprise counterattack on December 16. The main attack came south of Aachen. Within a week some 24 German divisions drove a wedge, called the Belgian or Ardennes "bulge," approximately 60 miles deep and 45 miles wide in the American lines, and surrounded the American 101st Airborne Division at Bastogne. But on December 27, American tank and infantry forces began to squeeze the German salient from the west, north, and south. They rescued the encircled troops in Bastogne; and by the end of January 1945 they had pushed the Germans back to their starting point. A short lull followed while each side braced for the final struggle.

During the lull in the west, the Russians applied heavy pressure in the east. They took Warsaw January 17, Cracow and Lodz on the 19th. On

AMERICAN MILITARY LEADERS OF THE EUROPEAN CAMPAIGN

Reading from left to right are: General George C. Marshall, American chief of staff, who was an outstanding planner of Allied military strategy; General Dwight D. Eisenhower, commander in chief of all the Allied forces taking part in the invasion of France; General Omar N. Bradley, commander of American ground forces in the European invasion; General George S. Patton, Jr., whose brilliant leadership of the American 3d Army disorganized and routed the Germans; and General Brehon B. Somervell, whose organizing ability provided the vast amounts of invasion supplies.

the 21st they launched two other drives. One pushed across the border of Silesia into southeastern Germany and reached Breslau by January 24. The other was aimed at Königsberg, capital of East Prussia, and at the seaport of Danzig. By the middle of February the Russians had plunged across the Oder River, about 32 miles northeast of Berlin, and farther south the Red army reached the city of Frankfort (on-the-Oder).

Now the western Allies threw their weight into the drive which crushed the Nazi power.

Collapse of Germany and Surrender by Japan

AFTER driving the Germans from the Ardennes bulge, the American advance forced the Germans to release water from the Schwammenauel Dam on the upper Roer February 10. This was the key to action everywhere, because the Americans had not dared to cross the Roer as long as a flood could be loosed upon them. Now the British drove forward from Nijmegen, the American 1st Army struck for Cologne, and the 3d Army broke into the Saar.

On March 7 the American 1st Army seized Cologne. Another drive a few miles to the south reached the Rhine at Remagen. Here the 9th Armored found the Ludendorff Bridge wired for demolition, but captured it intact. While this force was expanding its bridgehead, the American 3d Army's armored units captured Coblenz on the Rhine March 18. It rushed across the Rhine through Frankfort (on-the-Main), and by March 30 it slashed almost half way across Germany.

The American 1st, 3d, and 9th armies and the British crossed the Rhine and pocketed a large part of the remaining German forces in the Ruhr. They ended all resistance by April 18. Then the British turned north toward Hamburg and Denmark, while the Americans pushed east to meet the Russians coming west.

German collapse was equally pronounced on other fronts. Budapest fell to the Russians February 13. Vienna followed, after a week's siege, April 13. In Italy the Allies broke through the Gothic Line at Bologna April 21, and the demoralized Germans fled across the Po. Ex-premier Mussolini was caught fleeing for safety near Como and was shot by partisans April 28.The next day the German forces in Italy surrendered unconditionally.

By now the German cause was utterly hopeless, but Hitler remained defiant even when the Russians attacked Berlin April 21. Later it was reported that he committed suicide the night of April 30 to escape capture by the Russians. Rumors of his death spread abroad instantly and broke the last vestiges of German spirit. On May 2 the Berlin garrison surrendered. On May 4 General Montgomery received surrender of the Germans in Denmark, the Netherlands, and northwestern Germany. General Jodl signed a surrender at Reims May 7; and on May 8 President Truman, Prime Minister Churchill, and Premier Stalin announced unconditional surrender by General Keitel the day before. The surrender was almost meaningless in a military sense, since all Germany was in the grip of the Allies; but it ended resistance by isolated groups, the most important being the German forces in Norway.

OTHER ALLIED MILITARY LEADERS

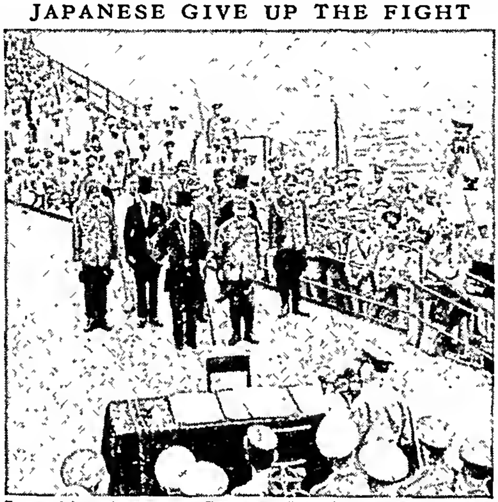
At left, Field Marshal Bernard L. Montgomery commander of the British 21st Army Group in France. Middle, Lieutenant General H. D. G. Crerar, commander of the Canadian 1st Army. At right, General Charles de Gaulle, commander of the Free French forces.

Before the German surrender, American and Russian troops had met April 26 at Torgau on the Elbe River. By May 8, the American 3d Army had plunged into western Czechoslovakia and Austria. But these limits, set by the outcome of the fighting, were not to prevail in the occupation. The Allies had already arranged the partition of Germany; and they proceeded to set up zones of occupation by the United States, Great Britain, Russia, and France. Berlin was in the Russian zone; but each one of the occupying nations was assigned a part of the city to control.

The Allies abolished the Nazi government, German land, naval, and air forces, as well as the Gestapo (secret police), and all other groups which might nurture the military tradition in Germany. Agriculture, mining, public utilities, industry, trade, transportation, and finance were placed under Allied control. Nazi officials, except a few necessary technicians, were dismissed from office; and an intensive man hunt was started to capture and bring to trial war criminals (*see also* Germany).

The United States also began the tremendous task of withdrawing unneeded military forces from Europe. Men who had given the longest service were screened out for discharge, while others were sent to the Pacific.

JAPANESE GIVE UP THE FIGHT



In a historic scene General MacArthur addresses Japanese representatives aboard the *Missouri* during the formal surrender ceremony Sept. 2, 1945.

Defeat of Japan

MEANWHILE events had been moving as steadily, if not quite so swiftly, in the Pacific theater. Even before the campaign on Leyte was ended, MacArthur had seized Mindoro Island. On Jan. 9, 1945, he landed an invasion force on the shores of Lingayen Gulf in Luzon and took the same road the Japanese had used when they conquered the island four years earlier.

For a time, the invaders met little effective opposition. They entered the outskirts of Manila February 4 and rescued some 3,000 prisoners from the Santo Tomás internment camp. But they encountered a fanatical last stand by the Japanese garrison in the old walled section of Manila. The Japanese slaughtered thousands of civilians and set fire to the business district. Then they fought virtually to the last man in a savage, house-to-house struggle which lasted until February 23. Thereafter the Americans pursued the remaining Japanese into the mountains to central Luzon but did not mop up the last pockets of resistance until months later.

Seizure of Iwo Jima and Okinawa

Meantime forces under Admiral Nimitz were seizing more island steppingstones for the final blows against the Japanese homeland. On February 19 the marines landed on Iwo Jima, about 700 miles south of Japan. The struggle lasted until March 16. Marine casualties were the heaviest suffered in any island invasion—19,938 killed, wounded, and missing.

On April 1, Nimitz landed 100,000 soldiers and marines on Okinawa, the largest island in the Ryukyu chain southwest of Japan. The Japanese were driven quickly into the southern end of the island; but there they held out fanatically in the mountainous terrain until June 21. During the campaign, the Navy suffered frequent attacks from *Kamikaze* (suicide) bomber pilots who deliberately dived their planes into ships.

Thereafter the Americans harried Japan with naval shelling of ports and aerial bombardment of cities by B-29's and carrier planes, while troops and supplies were assembled for the final assault. On July 26, Allied leaders meeting in Potsdam, Germany, demanded that Japan immediately surrender or face "utter destruction." But the Japanese determined to fight on. Shortly afterward, on August 8, Russia attacked Japanese forces in Manchuria.

Atomic Bombs End War

At this juncture, American scientists made a great contribution to the war effort. During the year they had released atomic energy in an atomic bomb (*see* Atoms). A trial bomb proved successful in a New Mexico test in July, and on August 6, a B-29 dropped another on the Japanese army base at Hiroshima, located on Japan's main island of Honshu. This single bomb destroyed approximately three-fifths of the city. Three days later a more powerful atomic bomb reduced the seaport of Nagasaki to ruins.

Stunned by the atomic bombs and the new threat from Russia, the Japanese accepted Allied surrender terms on August 15. On Sept. 2, 1945 (this date was September 1 in the United States), Japan formally surrendered aboard the battleship *Missouri* anchored in Tokyo Bay. General MacArthur signed as Supreme Commander for the Allied Powers, and Fleet Admiral Nimitz signed as the United States representative.

General MacArthur immediately established military occupation of the empire. After the surrender, American troops went ashore to liberate war prisoners and to make certain that the terms of surrender were complied with. All Japanese military forces were disarmed and sent home. The emperor and other government officials were allowed to stay in office, but they were obliged to obey General MacArthur's orders. Only those industries which would not enable the nation to rearm for war were permitted to operate. Japan's war leaders—particularly those charged with cruelties to prisoners—were arrested and held for trial, and measures were taken to start a democracy.

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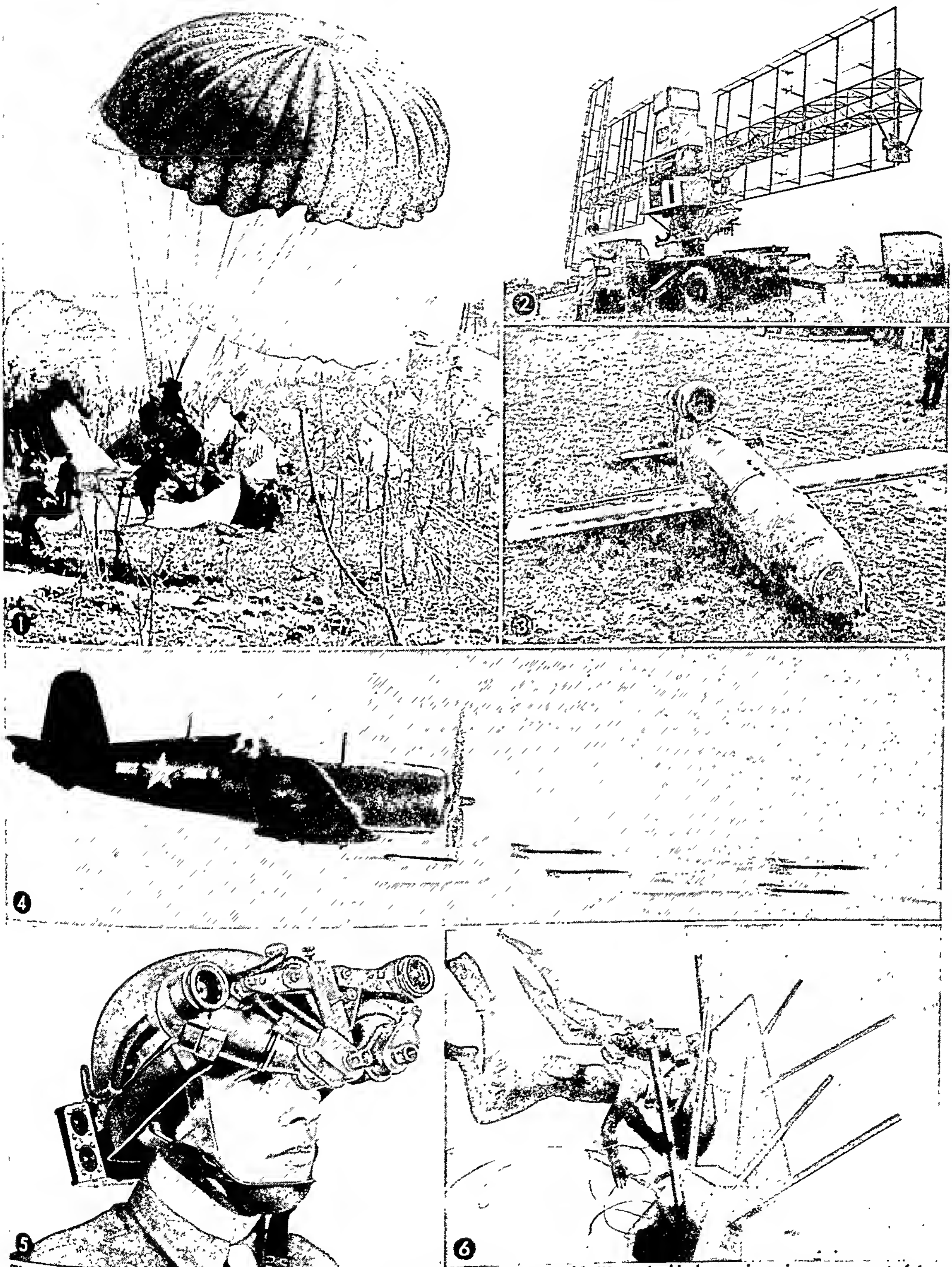
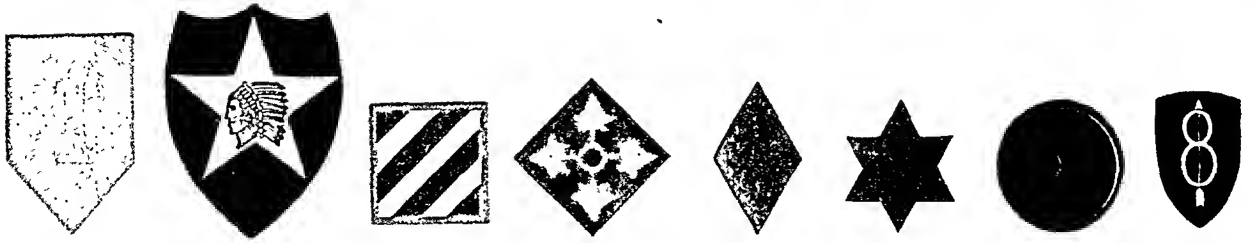
NEW WEAPONS AND TACTICS OF THE SECOND WORLD WAR



These are some of the new tactics and weapons used in the second World War. 1. Air-borne invasion, represented by American paratroops dropping on Corregidor to recapture that fortress. 2. Radar, the method of detection which pierced darkness, fog, and storm. 3. Jet propulsion, exemplified by the V-1 bomb. 4. Rockets fired from racks beneath a plane's wings. 5. Infrared rays used in this "snooperscope" to detect objects and men at night. 6. Underwater demolition squads of specially trained and equipped swimmers who destroyed anti-invasion barriers along seacoasts and beaches.



1st "The First" Tunisia, Sicily, Normandy, the Bulge, Germany

2nd "Indian Head" Normandy, the Ardennes, Leipzig

3rd "Marne" Sicily, Cassino, Anzio, Colmar pocket, Salzburg

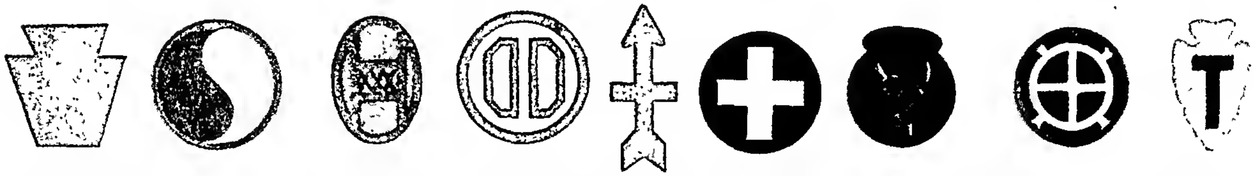
4th "Ivy" Cherbourg, Bastogne

5th "Red Diamond" Metz, Luxemburg, Mainz-Worms bridgehead

6th "Sight-seeing" Sansapor in New Guinea, northern Luzon

7th "Hour Glass" Attu, Kwajalein, Leyte, Okinawa

8th "Golden Arrow" Brittany, Duren, Cologne plain



28th "Keystone" Paris, Hurtgen Forest, Colmar pocket

29th "Blue and Gray" D-day in Normandy, St Lô, Siegfried Line, Aachen

30th "Old Hickory" St Lô, Aachen, Siegfried Line, Rhine crossing

31st "Dixie" Morotai, Davao in southern Mindanao

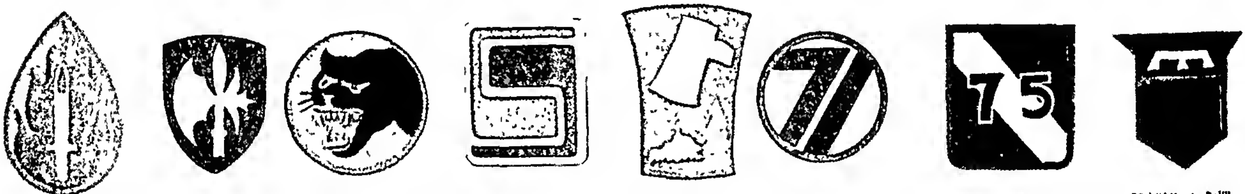
32nd "Red Arrow" Buna, Aitape in New Guinea, Leyte

33rd "Prairie" Baguio in northern Luzon

34th "Red Bull" Tunisia, Cassino, Livorno, Bologna

35th "Santa Fe" St. Lô, Metz, Nancy, Ardennes, Ruhr

36th "Texas" Salerno, Cassino, France, Germany



63rd "Blood and Fire" Colmar pocket, Bavaria, Danube River

65th "Battle-Axe" Saarlautern, Regensburg, Danube River

66th "Black Panther" Lorient, St Nazaire, Army of Occupation

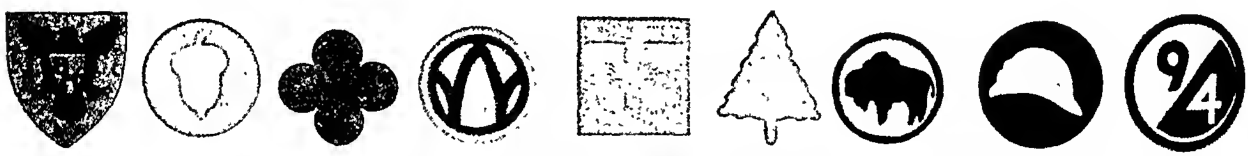
69th "Fighting Sixty-Ninth" Siegfried Line, First to link up with Russians in Germany

70th "Trail Blazers" Saarbrucken, German Occupation

71st Siegfried Line, Hardt Mountains, Danube River

75th Battle of the Ardennes Bulge, Westphalia

76th "Liberty Bell" Luxemburg, German Occupation



86th "Black Hawk" Dachau, southern Germany, Danube River

87th "Golden Acorn" Ardennes, Coblenz, Black Forest

88th "Cloverleaf" Rome, Gothic Line northern Italy

89th "Rolling W" Bingen, Eisenach, Czech Border

90th "Tough 'ombres" Normandy, Metz, Czechoslovakia

91st "Wild West" Arno River, Pisa, Bologna

92nd "Buffalo" Arno River, Po Valley, Genoa

93rd Bougainville, Morotai, Philippines

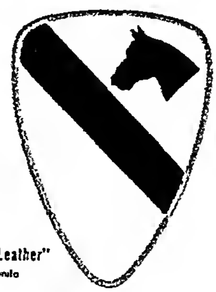
94th Brittany, Siegfried Line, Moselle River, Saar

103rd "Cactus" Wissembourg, Stuttgart, Austria

104th "Timber Wolf" Rhine crossing, Cologne, Ruhr

106th "Golden Lion" St Vith, Battle of the Bulge

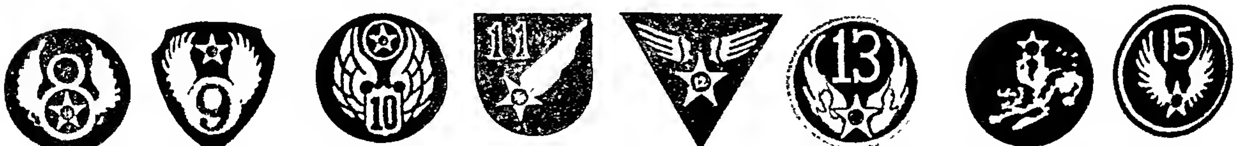
Americal Guadalcanal, Bougainville, Cebu Island in Philippines



1st Cavalry "Hell for Leather" Negros, Leyte, Manila

Army Air Forces Headquarters Insignia is basic design for other AAF patches

Mediterranean Allied Air Force Composed of U. S. and British air commands, fought over southern Europe



Eighth Air Force Headquarters in England, carried out heavy bomber raids over Europe

Ninth Air Force Headquarters in England, carried out tactical raids over Europe

Tenth Air Force Headquarters in India, covers India-Burma area

Eleventh Air Force Headquarters in Aleutians, covers Northern Pacific

Twelfth Air Force Headquarters in Italy, carried out tactical Mediterranean raids

Thirteenth Air Force Headquarters in Southwest Pacific, covers this area

Fourteenth Air Force Headquarters in Chungking, covers China

Fifteenth Air Force Headquarters in Italy, carried out strategic Mediterranean raids

INSIGNIA AND WHERE THEY FOUGHT

9th "Varsity" — El Guettar, Bizerte, Sicily, Cotentin Peninsula, German Occupation

10th Mountain — Arno River, Po Valley

11th Airborne — Leyte, Manila, Cavite

13th Airborne — Units in Italy, southern France

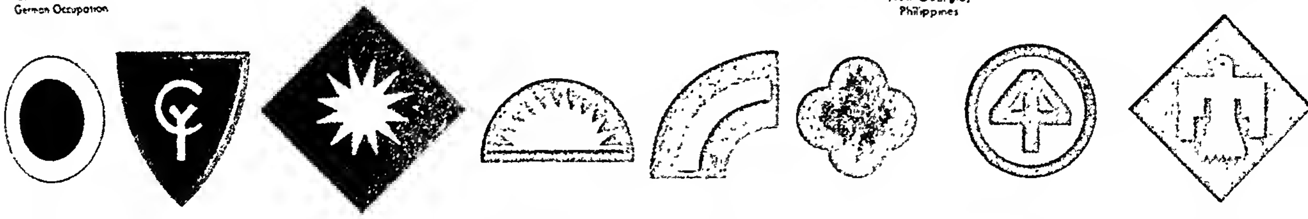
17th Airborne — Parachuted across Rhine

24th "Victory" — New Guinea, Leyte, Corregidor, Verde Island, Mindanao

25th "Tropic Lightning" — Guadalcanal, New Georgia, Philippines

26th "Yankee" — Battle of the Bulge, Siegfried Line

27th "New York" — Makin Island, Saipan, Okinawa



37th "Buckeye" — Munda, Bougainville, Lingayen Gulf, Manila

38th "Cyclone" — The recapture of Bataan

40th "Sunburst" — Negros, Luzon, Panay Island in Philippines

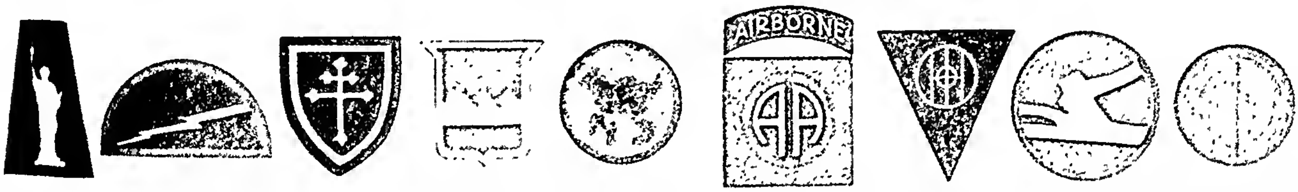
41st "Jungleers" — Salamaua, Marshalls, Mindanao, Palawan

42nd "Rainbow" — Schweinfurt, Munich, Dachau

43rd "Winged Victory" — New Georgia, New Guinea, Luzon

44th — The Saar, Ulm, Danube River

45th "Thunderbird" — Sicily, Salerno, Cassino, Anzio, Belfort Gap



77th "Statue of Liberty" — Guam, Leyte, Okinawa

78th "Lightning" — Aachen, Remagen, Roer River

79th "Lorraine" — Cherbourg, Normandy breakthrough, Vosges Mountains

80th "Blue Ridge" — Normandy, Moselle River, relief of Bastogne

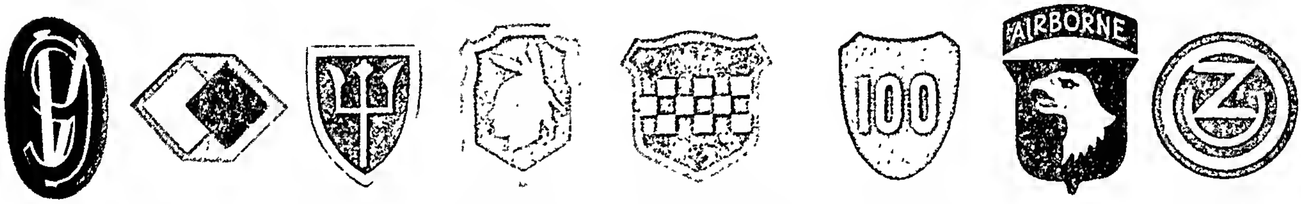
81st "Wildcat" — Angaur, Peleliu and Ulithi

82nd Airborne "All American" — Sicily, Normandy, Nijmegen, Ardennes

83rd "Thunderbolt" — St. Malo, Roer, Ardennes

84th "Railsplitters" — Siegfried Line, Ardennes, Hanover

85th "Custer" — Rome, Po Valley



95th "Victory" — Metz, Moselle River, Siegfried Line, Saar

96th "Deadeye" — Leyte, Okinawa

97th "Trident" — Ruhr pocket

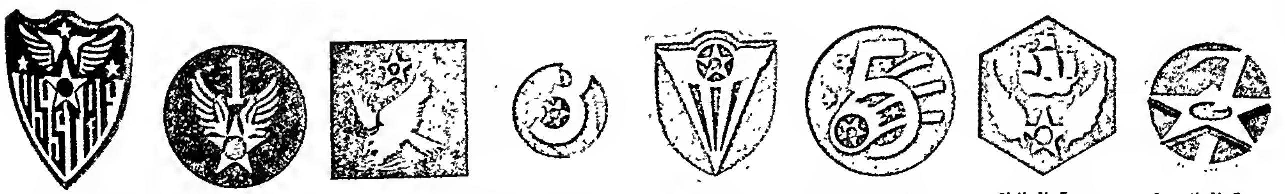
98th "Iroquois" — Hawaii

99th "Checkerboard" — Ardennes, Remagen bridgehead

100th "Century" — Bitche, Saar

101st Airborne "Screaming Eagle" — Normandy invasion, Bastogne

102nd "Ozark" — Siegfried Line, Rhine-Elbe, München-Gladbach



U. S. Strategic Air Force — Made up of U. S. 8th, 15th Air Forces, directed heavy bomber raids over Europe

First Air Force — Headquarters at Mitchel Field, N. Y., protects Atlantic Seaboard

Second Air Force — Headquarters at Colorado Springs, protects western U. S.

Third Air Force — Headquarters at Tampa, Fla., protects southeastern U. S.

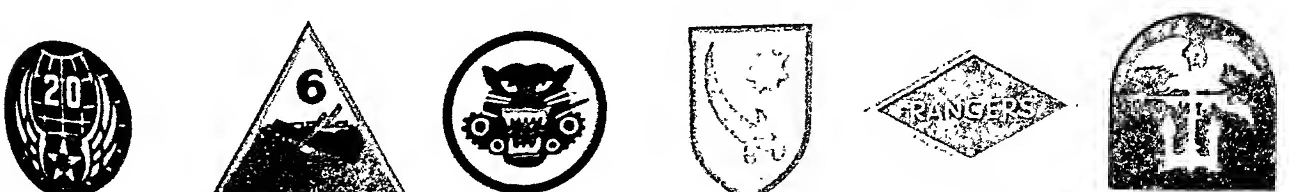
Fourth Air Force — Headquarters at San Francisco, protects U. S. Far West

Fifth Air Force — Headquarters in the Philippines, patrols Southwest Pacific

Sixth Air Force — Headquarters in Canal Zone, protects Caribbean area

Seventh Air Force — Headquarters in Marianas, covers Central Pacific

ARMORED AND SPECIAL UNITS



Twentieth Air Force — Headquarters in Washington, D. C., superbomber force against Japan

6th "Super Sixth" — Brest, Normandy breakthrough, Bastogne, the Saar

Tank Destroyer Units — Attached to all Ground Force divisions

Persian Gulf Service Command — Moved Lend-Lease supplies to Russia

Rangers — Specially-trained battalions which fought in Italy and France

Army Personnel, Amphibious — Assigned to Amphibian Units

Campaigns and Battles of the Second World War

(The first nine pages of this pictorial history are devoted to action in Europe and North Africa. The remaining nine pages show action in the Pacific and in the Far Eastern theater of operations.)

Hitler Conquers Western Europe

HITLER'S *blitzkrieg* (lightning war) against Poland launched the second World War Sept. 1, 1939. Nine months later the swift-striking German war machine had overrun seven countries in western Europe—Poland, Denmark, Norway, Luxemburg, the Netherlands, Belgium, and France.

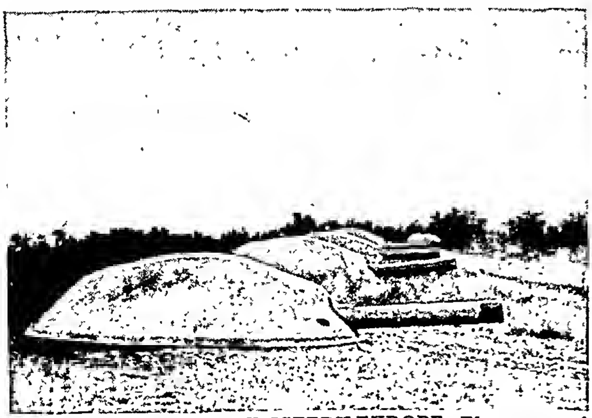
along the Western Front. The strong German Siegfried Line discouraged any Allied attack in that direction. Across the border, French troops occupied the so-called "impregnable" Maginot Line. But while the Allies waited for a frontal attack during this *sitzkrieg*, the Nazis prepared to strike on the flanks. Meanwhile the Russo-Finnish war, Nov. 30 1939–March 12, 1940, gave the Soviet Union important slices of Finnish territory.

BATTLE OF POLAND. Left, a German motorized unit roars through a bomb-shattered Polish town. Above, Poland's horse-drawn artillery plods to the front in a vain effort to halt the Nazi mechanized war machine.

Battle of Poland. On Sept. 1, 1939, the German *Luftwaffe* (air force) and dive-bombing *Stukas* crossed the frontier and destroyed the small Polish air fleet while it was still on the ground. On the same day, swift-moving Nazi *Panzer* (armored and mechanized) divisions smashed into Poland from three directions. The Polish army was the fifth largest in Europe, but it was utterly unequipped to meet the furious onslaught of the Nazis. The Germans crushed organized opposition in 16 days, and Russia completed the rout by attacking from the east September 17. Warsaw surrendered September 27, ending all resistance.

Early Stalemate in Western Europe. From Sept. 1, 1939, until May 10, 1940, there was no major action

Conquest of Norway. Striking without warning April 9, 1940, the Nazis occupied Denmark without opposition and attacked Norway. Landing air-borne infantry, parachute troops, and amphibious forces at many points, the Germans gained a solid foothold the first day of the attack. The invaders were assisted by a "fifth column" of Norwegian traitors led by Major Quisling. British troops landed April 15 at Namsos and Aandalsnes to aid the demoralized Norwegian forces. But the swift German advance forced them to flee central Norway May 1–3 and evacuate Narvik June 9. This ended Allied resistance in Norway.



EARLY STALEMATE IN WESTERN EUROPE. These guns of the Maginot Line, as well as those of the Siegfried Line, remained quiet throughout 1939 and early 1940.

CONQUEST OF NORWAY. Hard-hitting British Commandos stab at German defenses in Norway, after Nazi forces had conquered that country in the spring of 1940.

Battle of Flanders. On May 10, 1940, the Germans turned to the west and launched a thunderous offensive against France. To protect their right flank the Nazi war machine roared into the Netherlands and Belgium. The same day Hitler struck at the weak extension of the Maginot Line in the Ardennes Forest. Both attacks met quick success. Dutch resistance was crushed in four days, while to the south Nazi armored spearheads drove 220 miles to reach the French coast at Abbeville May 21. This maneuver trapped the entire left wing of the Allied armies

BATTLE OF FLANDERS ENDS IN EVACUATION AT DUNKIRK. Weary British troops take a last, bitter look at the flaming French coast as a transport carries them back to England.

in a small pocket on the English Channel. Under heavy fire from German aircraft and artillery a hastily assembled fleet evacuated more than 335,000 Allied troops from Dunkirk to England May 29–June 4, 1940.

Battle of France. The stunning defeat in the battle of Flanders rendered the French helpless to halt the next German blow. On June 5, 1940, the Nazis attacked along a 100-mile front from Abbeville east to Sedan. One armored spearhead raced south along the French coast closing the Channel ports to possible British aid. In the center, the Germans knifed through the Somme and Aisne River lines and smashed toward Paris from east and west. Another column turned to the left after breaking through at Sedan and took the Maginot Line from the flank and rear. Paris fell to the Nazis June 14, and the French asked for surrender terms June 17. Meanwhile Italy declared war on France June 10 but engaged in no major action.

BATTLE OF FRANCE. German flame throwers and gunfire conquer a concrete pillbox in an attack on the Maginot Line from the flank and rear.

Limiting the Nazi Advance

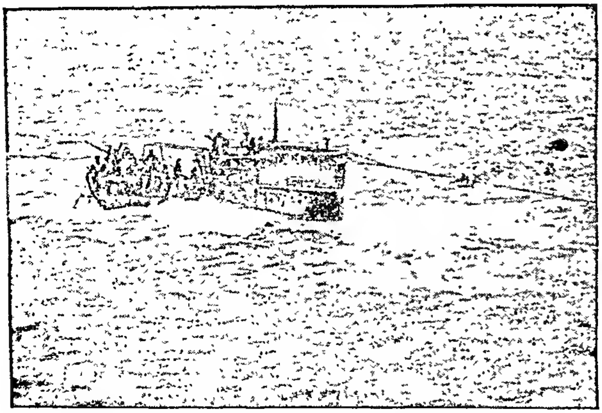
LATE IN 1940 Germany lost its first battle of the war when England refused to succumb to a savage air bombardment. In 1941 the Nazis completed their conquest of the Balkans. Then they attacked Russia, reaching the outskirts of Moscow before being halted. In 1942 they suffered defeats in the Atlantic and Africa.

BATTLE OF BRITAIN. London firemen fight ravaging fires which followed a night raid by German bombers.

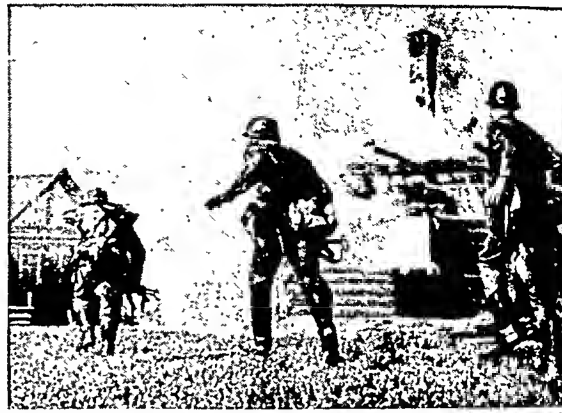
Battle of Britain. On Aug. 8, 1940, Hitler unleashed a furious air assault on England to soften the British Isles for invasion. Huge formations of German bombers roared over the Channel almost daily to blast seaports, industrial cities, and airfields. But despite this steady rain of high explosive bombs and incendiaries, British resistance remained firm. And heroic counterattacks by fighter planes of the Royal Air Force took a terrible toll of the *Luftwaffe* raiders. Britain's victory was assured October 6 when the Nazis abandoned daylight raids that had cost them 2,375 planes and crews, or about 10 per cent of the attacking armadas. Night raids later spread terror and destruction, especially in London, but they had little military value.

German Drive Through the Balkans. On April 6, 1941, the Nazi war machine plunged into Yugoslavia and Greece to complete Hitler's conquest of the Balkans. Yugoslavia was overrun by April 17, and Greece surrendered April 30. Of the 74,000 British imperial troops in Greece only about 44,000 escaped. Many of these fled to Crete and were captured or killed when Nazi airborne troops took that island May 20–June 1, 1941.

GERMAN DRIVE THROUGH THE BALKANS. British troops slump on a transport as they leave Greece.

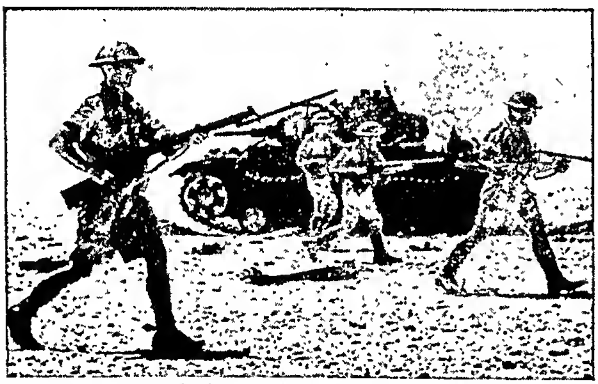


BATTLE OF THE ATLANTIC. Nazi seamen scramble frantically from a badly crippled submarine. It was driven to the surface by depth charges dropped from U. S. vessels.



BATTLE OF STALINGRAD. German troops rush to attack in savage house-to-house fighting as Russian homes burn. But the furious three-month assault failed to take the city.

Battle of the Atlantic. Germany blockaded Europe by attacking Allied ships with land-based bombers and "wolf packs" of submarines. The Allies countered by convoying their ships with destroyers and planes from baby escort carriers. These defenses brought the menace under control by 1942.



BATTLE OF EL ALAMEIN. British infantry advances past wrecked and burning Nazi tanks of Field Marshal Rommel's *Afrika Korps*. Armored forces then routed the Germans.

Battle of El Alamein. In June 1942, Italian forces and the Nazi *Afrika Korps* penetrated Egypt in a drive for the Suez Canal. The British Eighth Army, however, held fast at El Alamein, 70 miles west of Alexandria. On October 23 British infantry cut through the Axis lines in a vicious bayonet charge that opened the way for an armored breakthrough. The attack forced the Axis back 1,300 miles across the desert.

Battle of Stalingrad. The high-water mark of the German invasion of Russia (begun June 22, 1941) was Stalingrad. On Aug. 24, 1942, the Nazis attacked the city, but the Russians resisted street by street and house by house. The powerful German Sixth Army spent itself in a futile effort to dislodge the stubborn defenders. On November 19 the Russians counterattacked and by Feb. 2, 1943, killed or captured 330,000 German troops that had been besieging the city.

Invasion of North Africa. On Nov. 8, 1942, the British and Americans landed troops at Algiers, Oran, and Casablanca in French North Africa (Operation Torch). Meeting little resistance, the invaders quickly drove inland. On November 15 the French aligned themselves with the Allies in Africa. Meanwhile the Axis hastily massed troops in Tunisia and on Jan. 12, 1943, stopped the advance at Medjez-el-Bab. United States divisions: 1st, 3d, 9th Infantry; 1st and 2d Armored.

INVASION OF NORTH AFRICA. [C]arrying the American flag (left) U. S. troops swarm ashore in the invasion of French North Africa. Within 48 hours th[e] assault forces had seized all the major ports and airfields in Morocco and Algeria.

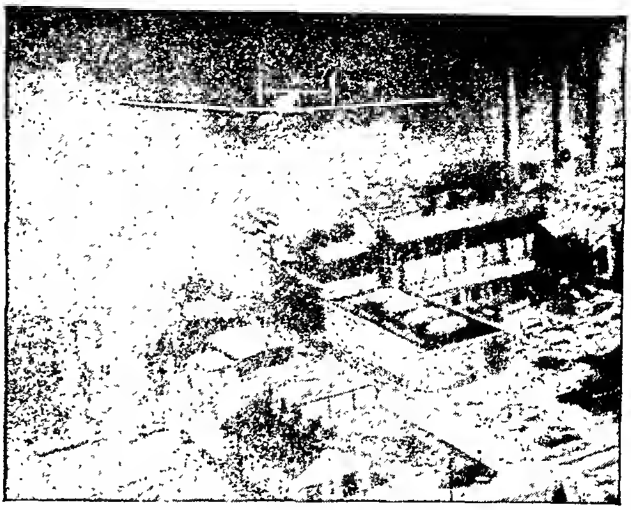
United Nations Fight Back

FOLLOWING the invasion of North Africa the Allies pressed forward relentlessly in the Mediterranean theater. American troops won battle stars for campaigns in Algeria-French Morocco (Nov. 8–11, 1942), Tunisia (Nov. 17–May 13, 1943), Sicily (July 9–Aug. 17, 1943), and Naples-Foggia in southern Italy (Sept. 9, 1943–Jan. 21, 1944). Meanwhile Allied bombers hammered hard at Hitler's "Fortress Europe."

Battle of Tunisia. American forces met their first defeat at the hands of the Germans in the battle for Kasserine Pass (Feb. 14–25, 1943). But they rallied to push through Tunisia and on April 7 met the British Eighth Army as it advanced from the east. On May 2 United States troops cleared Hill 609, Nazi bastion 13 miles from Mateur. With their backs to the sea on Cape Bon, 250,000 Germans and Italians surrendered to the Allies May 12, 1943. United States divisions (II Corps): 1st, 9th, 34th Infantry; 1st Armored; British First and Eighth Armies and Free French.

BATTLE OF TUNISIA. An American Ranger battalion advances over the brush-covered hills of North Africa toward Mateur, the key to the Axis defense in the Bizerte-Tunis region.

Battle of Sicily. On July 10, 1943, the British and Americans launched Operation Husky, the invasion of Sicily. The British Eighth Army landed at Cape Passero and advanced up the eastern coast. The United States Seventh Army led by General Patton won a beachhead at Gela after a desperate struggle. Then General Bradley's II Corps and General Truscott's task force cut through the center of the island and swept up the western coast. The Americans ended the campaign by capturing Messina August 17. Axis casualties were 167,000; the United States lost 31,158 killed, wounded, and missing. United States divisions: 1st, 3d, 9th, 45th Infantry; 2d Armored, 82d Airborne.

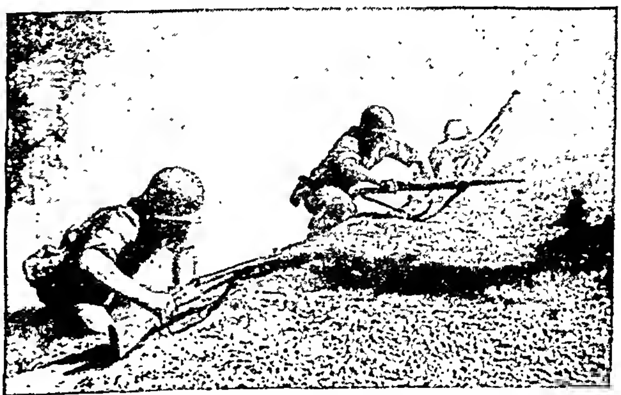


BOMBING OF PLOESTI. A B-24 (Liberator) swoops down for a low-level attack on Ploesti, as dense clouds of oil smoke rise from fires set by earlier waves of bombers.

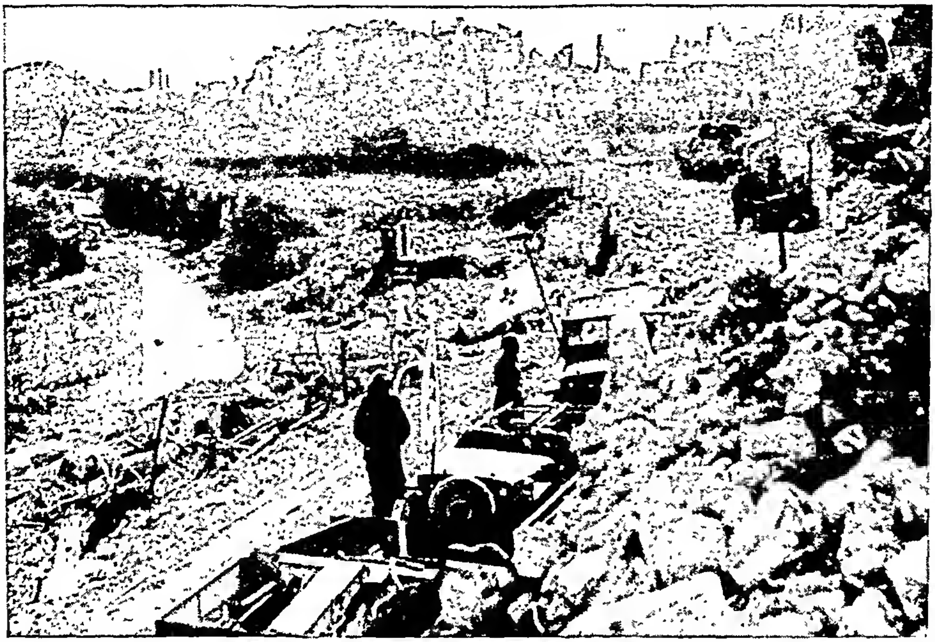
Bombing of Ploesti. On Aug. 1, 1943, 178 American B-24 (Liberator) bombers flew a 2,400-mile round trip from Libya to smash at Ploesti, Rumania. The low-level attack crippled the chief petroleum center of Hitler's Europe, but the raid cost 54 bombers of the United States Ninth Air Force. A year later the Ploesti target was knocked out in a savage three-day assault that cost 2,277 American airmen and 270 planes.

Battle of Salerno. The British Eighth Army invaded Italy at the toe of the boot Sept. 3, 1943 (Operation Avalanche). Six days later the American Fifth Army landed at Salerno, south of Naples. General Clark's assault divisions: 36th and 45th Infantry and a Ranger force, reinforced by the 82d Airborne and the 3d Infantry divisions. For six critical days Axis armor attacked savagely. But naval gunfire and close air support helped the invaders break out of the beachhead September 15. The next day they joined the Eighth Army coming from the south. The capture of Naples October 1 rounded out this campaign and opened the way for a bitter winter struggle at Cassino.

BATTLE OF SICILY. U. S. infantrymen of the Seventh Army push through smoke from burning buildings to take Messina at the northeast tip of the island.



BATTLE OF SALERNO. Under cover of a smoke screen a U. S. Ranger patrol presses up a hillside in a vigorous attack to widen the beachhead at Salerno, Italy.



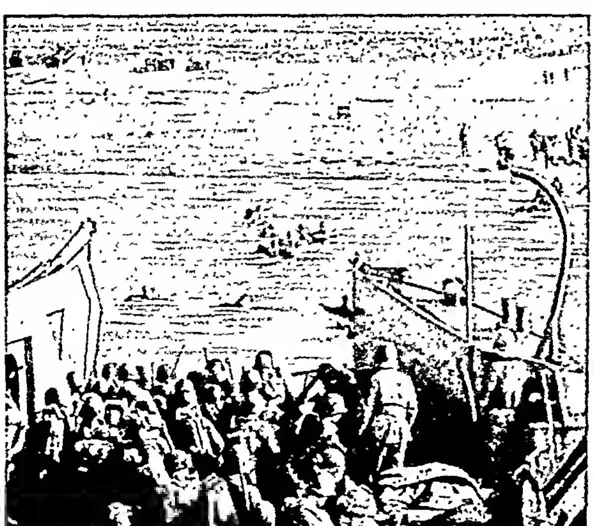
BATTLE OF CASSINO. Mechanized troops of the Fifth Army advance into the bomb-blasted town of Cassino, Italy. Despite heavy pounding by Allied bombers and artillery, Nazis clung stubbornly to the town from December 1943 until May 18, 1944.

D-Day—Greatest Invasion in History The long awaited invasion of Europe from the west came in June 1944. During the liberation of France that followed, American troops won battle stars for campaigns in Normandy (June 6–July 24), in Northern France (July 25–Sept. 14), and in Southern France (Aug. 15–Sept. 14).

Allied Invasion of France. For almost three years bombers had pounded the French and German coast. Then on June 6, 1944, from a fleet of 4,000 ships, the Allies stormed ashore at Normandy (Operation Overlord). Earlier in the day the 82d and 101st Airborne divisions parachuted inland. Infantry divisions: 4th at Utah beach, 1st and 29th at Omaha beach (American First Army); three British and one Canadian.

Battle of the Normandy Hedgerows, June 6–July 25, 1944. From the Normandy beaches the Allies thrust inland in the face of enemy mortars, machine guns, and riflemen at every hedgerow. But relentless attacks slowly forced the Nazis back. Meanwhile to the west, the 4th, 9th, and 79th Infantry divisions of the VII Corps fought their way into Cherbourg June 27. Other divisions of the First Army: 1st, 2d, 5th, 8th, 28th, 29th, 30th, 35th, 83d, 90th Infantry; 2d, 3d, 4th, 5th, 6th Armored.

Battle of Cassino. By December 1943 the Fifth Army advance in Italy was stopped at the Gustav Line based on Cassino. Despite heavy bombardment by air and artillery the Nazis clung stubbornly to their defenses. On Jan. 22, 1944, the VI Corps landed behind the Gustav Line at Anzio but failed to break the stalemate. The assault troops were the 3d Infantry Division, Rangers, paratroops, and a British division. The 34th and 45th Infantry and 1st Armored divisions landed later. Finally on May 18 the Allies overran Cassino and linked up with the Anzio forces a week later. The Fifth Army then advanced 75 miles to take Rome June 4. Fifth Army divisions at Cassino and the Rapido: 36th, 85th, and 88th Infantry.



ALLIED INVASION OF FRANCE, June 6, 1944. These troops of the U. S. First Army stream ashore from landing craft onto Normandy beaches in the face of shattering enemy fire.

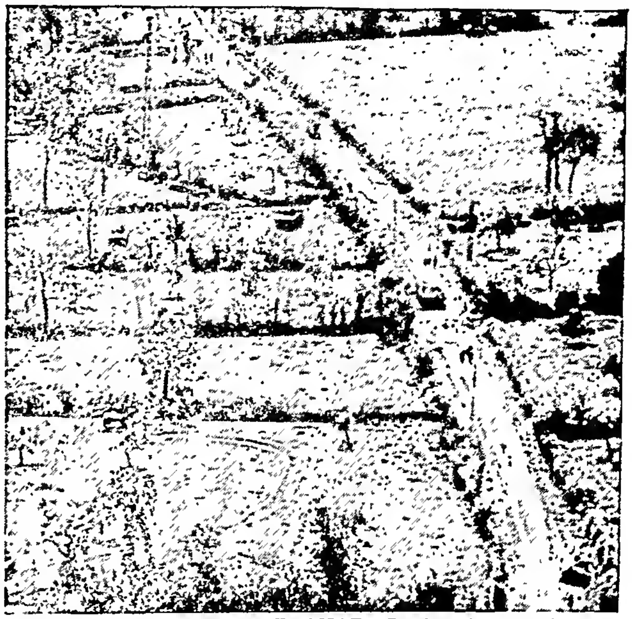
BATTLE OF THE NORMANDY HEDGEROWS. These infantrymen drive forward, with sudden death lurking behind every hedgerow, to expand their beachhead in France.


BREAK-THROUGH AT ST. LÔ. Infantrymen of the U. S. First Army warily pick their way through the ruins of bomb-torn St. Lô. The Americans entered the city July 18.

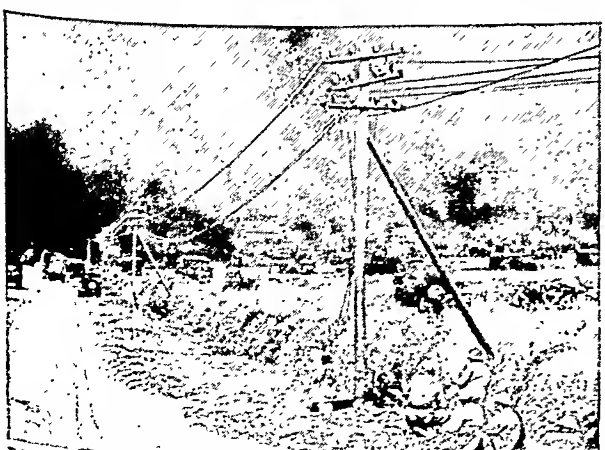
Break-through at St. Lô. On July 18, 1944, the First Army fought its way into St. Lô where formidable Nazi defenses blocked the advance. But after Allied planes had delivered a crushing air bombardment, the First Army smashed through the German lines and broke out of the beachhead July 25. Racing through the gap General Patton's Third Army captured Avranches July 31. Four days later, a daring attack by American tanks cut off the Brittany Peninsula. Meanwhile on July 18 the British and Canadians crossed the Orne River at Caen and struck south.

Battle of Falaise-Argentan Pocket. On the left flank of the Third Army the XV Corps pushed east to capture Le Mans August 9, then turned north toward Argentan. Meanwhile the Canadian First Army advanced south to Falaise. By August 17 these two Allied thrusts had trapped the German Seventh Army in a pocket between Argentan and Falaise. Five days later the Allies had captured 100,000 prisoners and killed many others who tried to escape. Divisions of the XV Corps: 79th, 90th Infantry; 5th Armored.

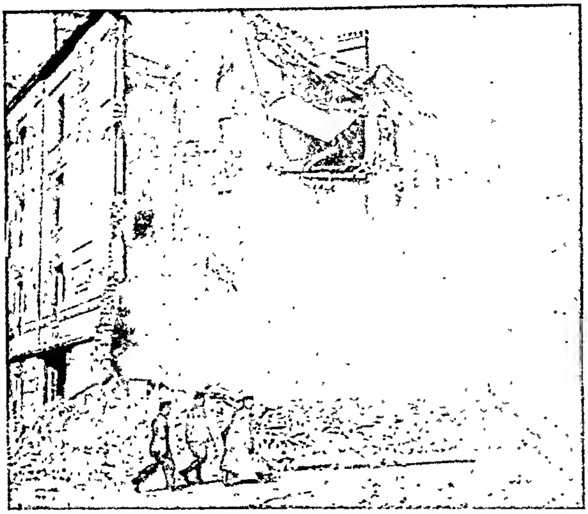
Swift Thrust across France. The stunning defeat at Falaise-Argentan broke the back of the Nazi defenses in France. The Third Army now thrust across France with three corps. The XV Corps wheeled at Argentan and smashed to the Seine northwest of Paris. The XII and XX Corps cut around the southeast of Paris. By August 20 the French capital was enveloped. The German garrison surrendered August 25.


SWIFT THRUST ACROSS FRANCE. Racing through the narrow St. Lô gap tanks of the Third Army rush relentlessly forward in their drive to liberate northern France.

Invasion of Southern France. On Aug. 15, 1944, the American Seventh Army invaded southern France in Operation Anvil. The 3d, 36th, and 45th Infantry divisions from Italy made the attack. They were reinforced by American paratroops and British and French units. Knifing through weak German defenses the Seventh Army raced up the Rhone Valley to join the Third Army near Dijon Sept. 11, 1944.


BATTLE OF FALAISE-ARGENTAN POCKET. The Canadian First Army halts briefly in its drive to Falaise as aircraft and artillery blast Germans trying to escape entrapment.


INVASION OF SOUTHERN FRANCE. On Aug. 15, 1944, infantrymen of the American 3rd Division wade ashore from landing craft and press inland up the Rhone Valley.



BATTLE OF AACHEN. Through clouds of smoke and dust three Nazi soldiers hurry to surrender to the 1st Infantry Division during the bitter struggle for Aachen.

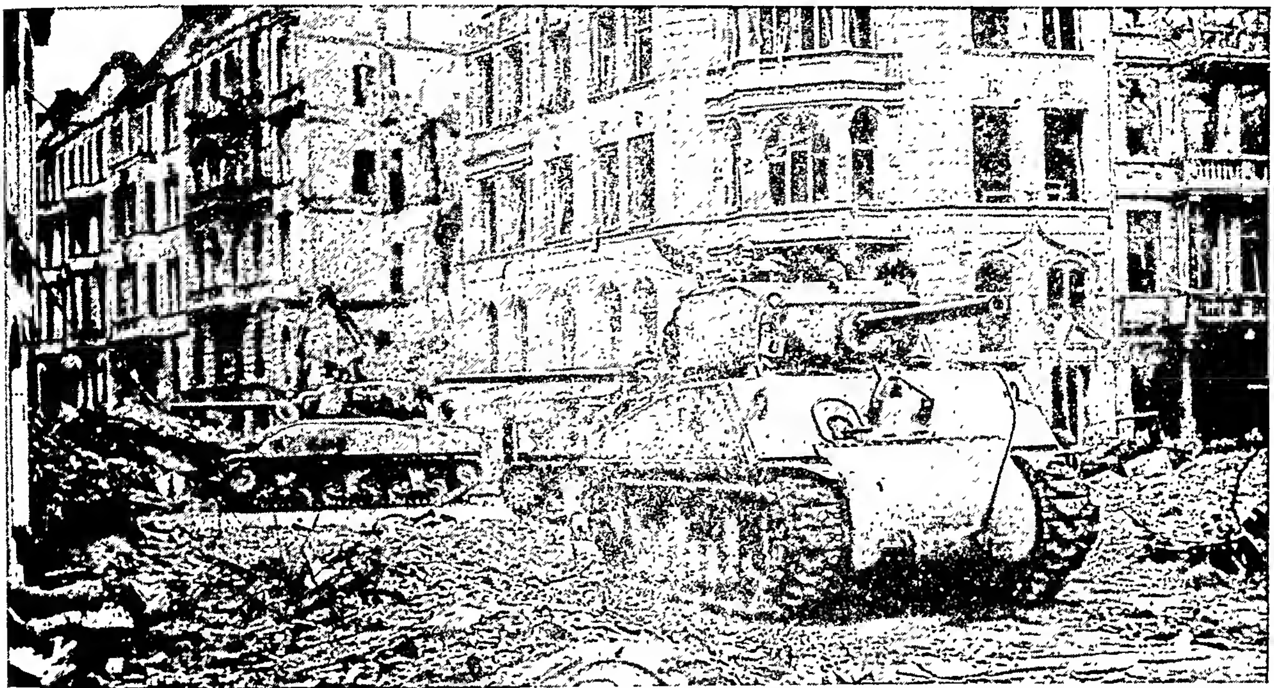
Crossing the German Border

THE Allied *blitzkrieg* reached the Netherlands and German border Sept. 11, 1944. By this time six combat armies were deployed generally north to south against Germany: Canadian First, British Second, United States First, Third, and Seventh, and French First. Meanwhile the American Ninth Army mopped up Nazis that held out in French ports. Later this force entered the line north of the American First. United States troops won battle stars for campaigns in the Rhineland (Sept. 15, 1944–March 21, 1945) and Ardennes (Dec. 16, 1944–Jan. 25, 1945).

Battle of Aachen, first large German city to be taken. On Oct. 11, 1944, the veteran 1st Infantry Division of the First Army entered the outskirts of Aachen. The Nazi defenders fought savagely, under Hitler's order to resist to the last man. They were not driven out until October 21. The city lay in ruins. Meanwhile the First Allied Airborne Army crossed the Rhine in the Nijmegen-Arnhem area September 20 but was driven back five days later. American units: 82d and 101st Airborne divisions.

Battle of the Bulge. On Dec. 16, 1944, the Nazis launched a furious counterattack in the Ardennes. While overcast skies grounded Allied planes 24 German divisions drove a bulge 60 miles wide and 45 miles deep into the American lines. Part of this success was won by a specially trained unit that wore American uniforms and drove captured American vehicles. The Germans, however, were finally halted by heroic resistance. The 1st, 2d, 4th, and 99th Infantry divisions held the shoulders of the bulge at Monschau and Echternach. Other brave stands were made at St. Vith by the 7th Armored, and at Bastogne by the 101st Airborne and Combat Command B of the 10th Armored. On December 26 the 4th Armored relieved encircled Bastogne, ending the crisis. The First and Third Armies eliminated the bulge during January. The Nazis lost 220,000 men and 1,400 tanks and assault guns. Allied casualties totaled 40,000.

BATTLE OF THE BULGE. Third Army infantry (top) attacks across a snow-covered field in Belgium to help relieve the 101st Airborne Division besieged at Bastogne. German infantrymen (bottom) press their attack past burning U. S. vehicles.



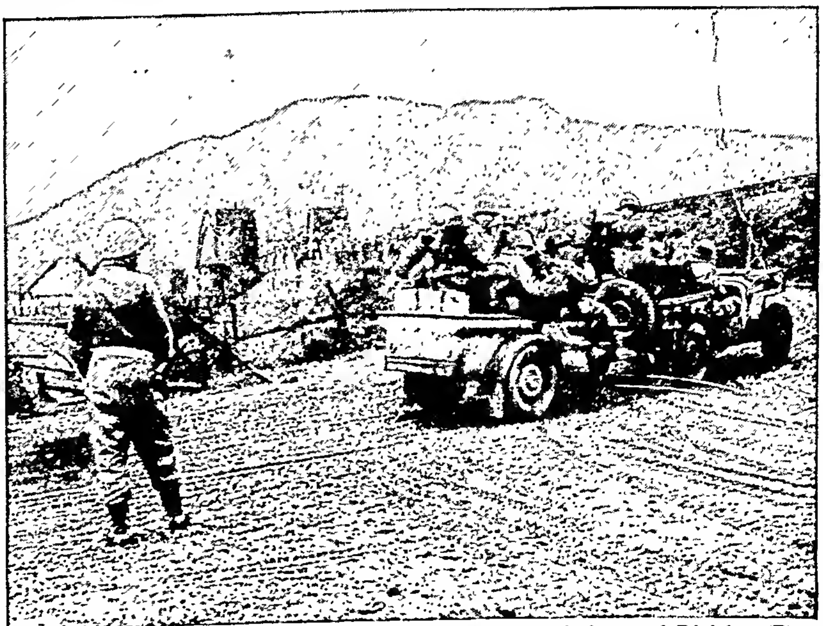
ATTACKING GERMANY FROM THE AIR. First Army tanks enter the shattered city of Cologne, which received the war's first 1,000-plane raid (May 30, 1942). These ruins show the devastation wrought by Allied bombing raids on German industrial centers.

Piercing the Heart of Nazi Germany

IN 1945 the Allies lunged across the Rhine and smashed through Germany to meet the Russians coming from the east April 25. Meanwhile they completed the conquest of Italy. Germany surrendered May 7, and the victory was announced the next day. In this final phase American troops won battle stars for campaigns in Central Europe (March 22–May 11) and the Po Valley in Italy (April 5–May 8).

Attacking Germany from the Air. When the Allies plunged into Germany proper they found first-hand evidence of the terrible destruction wrought by the American and British saturation bombing raids. Industrial centers were crushed by a steady storm of high-explosive and incendiary bombs. Bridges were blown, railroad yards smashed, and harbors crammed with the debris of sunken vessels. Most of this devastation occurred in the later stages of the war. Of the 2,697,473 tons of bombs dropped on Nazi-held Europe, less than one-fifth fell before 1944 and less than one-third before July 1944. Thereafter the raids became more widespread and punishing. In these attacks the Allies selected their targets carefully to make each blow hurt to the utmost. Of the entire bomb tonnage, 32.1 per cent landed on ground transportation targets and 9.3 per cent on oil, chemical, and rubber centers. Meanwhile the *Luftwaffe* had been virtually swept from the skies by hard-hitting Allied fighter planes.

Americans First to Cross the Rhine. On February 10 a long, grinding drive through the Hurtgen Forest took dams on the upper Roer River and ended danger of flooding the troops below. The First Army promptly attacked and reached the Rhine at Cologne March 7. The same day the 9th Armored Division captured the Ludendorff bridge intact at Remagen. This action breached the last natural German defensive position. In the meantime Patton's Third Army swept the Nazis from the Saar and the Palatinate and unexpectedly crossed the Rhine near Oppenheim. By March 31 all seven Allied armies were smashing deep into Germany.



AMERICANS FIRST TO CROSS THE RHINE. The 9th Armored Division (First Army) crosses the Ludendorff Bridge over the Rhine at Remagen. Earlier, 11 Americans had made a spectacular dash across the bridge to thwart destruction by explosives.

Drive Through Germany. After crossing the Rhine the Americans sprang a gigantic trap on the defending Germans. North of the industrially rich Ruhr, the Ninth Army drove straight east, while the First Army broke out of their Remagen bridgehead and struck east and north. On April 1 the two columns joined at Paderborn, cutting off the Ruhr in the largest pocket envelopment in the history of warfare. While the 15th Army held the west face of the pocket along the Rhine, units from the First and Ninth drove in to crush the enemy in 18 days and take more than 300,000 prisoners. Elsewhere the Canadian First Army routed the Germans in the Netherlands and the British, Americans, and French swept through Germany. On April 25 the 69th Infantry Division met Russian forces advancing from the east at Torgau on the Elbe River. This juncture sealed the fate of Germany. Meanwhile the Third and Seventh Armies plunged into Czechoslovakia and Austria. Total Axis casualties after June 6, 1944, on the Western Front were: 263,000 killed, 49,000 permanently disabled, and 7,614,794 captured.


FINAL ATTACK IN ITALY. Rockets from an Allied fighter plane (upper right) have set fire to German barracks at Postumia, as the Allies launch their final assault in Italy.


DRIVE THROUGH GERMANY. As smoke from burning buildings darkens the sky, tanks and the 30th Infantry Division of the Ninth Army smash at Born in the heart of Germany.

Final Attack in Italy. Slugging their way northward up the Italian boot the Allies won campaigns in the Rome-Arno region (Jan. 22–Sept. 9, 1944) and in the North Apennines (Sept. 10, 1944–April 4, 1945). On April 9 they launched Operation Grapeshot, a mass assault designed to smash the Germans in northern Italy. The American Fifth and British Eighth Armies broke through Nazi defenses and drove the demoralized enemy across the Po River April 23. The Allies accepted the surrender of all German forces in Italy May 2. Total Axis losses in Italy were 86.000 killed, 15,000 permanently disabled, and 357,089 captured. Between June 1944 and January 1945 the Fifth Army was reinforced by three fresh divisions: 91st and 92d Infantry and 10th Mountain.

Russians Conquer Berlin. The Soviet counteroffensive launched at Stalingrad slowly threw back the Germans along the entire front from Leningrad to Sevastopol. During the autumn of 1944 the crushing Red advance forced the Nazis to withdraw from the Balkans. In January 1945 the Russians pushed across the German frontier and on April 21 they attacked Berlin. Here the Nazis offered their last bitter resistance, defending the city with all their dying strength. But on May 2, the Soviet forces completed the conquest of the burned and battered German capital in the final decisive action in the European theater.


RUSSIANS CONQUER BERLIN. Russian soldiers raise their flag to hail capture of the German capital May 2, 1945, in the last major battle of the European phase of the war.

ATTACK ON PEARL HARBOR. Left, the destroyer *Shaw* lies a twisted mass of wreckage in the heavily hit drydock. Right, through dense smoke men swarm over the side of the listing battleship *California*, badly crippled by Japanese torpedoes and bombs.

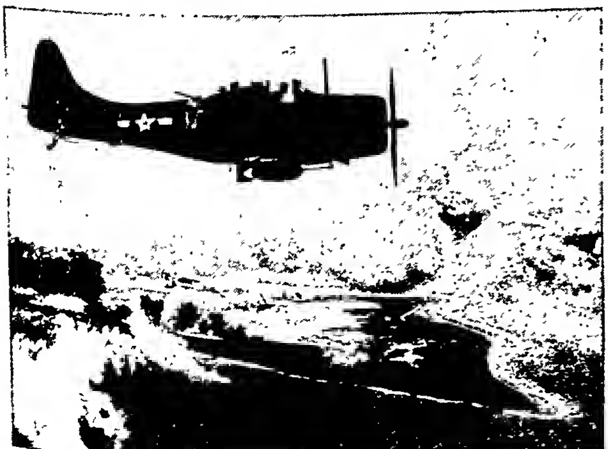
Early Defeats in the Pacific

JAPAN'S entry into the second World War turned the Pacific Ocean into one gigantic battlefield. By June 1942 the Japanese controlled the ocean from Asia to the International Date Line and from the Kuril Islands south to the Solomons, about 10 degrees below the equator. (Times and dates for the Pacific war are given as of the time zone where the action occurred.)

Attack on Pearl Harbor. In a surprise attack the Japanese struck at the United States Pacific Fleet at Pearl Harbor Dec. 7, 1941. The enemy force consisted of 105 planes from three carriers and submarines. They sank the battleships *Arizona* and *Oklahoma* and severely damaged a number of other vessels. Almost all the 475 army and navy planes on the base were destroyed on the ground. Known Japanese losses totaled 3 submarines and 41 planes. American soldiers and sailors killed numbered 2,898.

Battle of Wake Island. On Dec. 8, 1941, the Japanese struck at Wake Island, a tiny American outpost 2.000 miles west of Honolulu. Major Devereux's 1st Marine Defense Battalion heroically fought off vastly superior enemy air and naval forces until forced to surrender December 23. Guam, the first American possession lost, had already fallen Dec. 11, 1941.

Battle of Singapore. The Japanese invaded Malaya on Dec. 8, 1941, and overran the peninsula in an eight weeks' campaign. On Feb. 2, 1942, they attacked the British naval base on Singapore. The island was prepared to resist assault from the sea but not from the skies or the jungles in the rear. Singapore surrendered February 15, exposing the East Indies and the Indian Ocean to the Japanese advance.



BATTLE OF WAKE ISLAND. Through smoke rising from an earlier attack, a U. S. carrier plane releases a bomb on Wake Island after the Japanese captured the outpost Dec. 23. 1941.

BATTLE OF SINGAPORE. Native troops fight fires started by Japanese bombers during the battle for the large British naval base. Singapore surrendered to the Japanese Feb. 15, 1942.

SIEGE OF BATAAN. American prisoners, hands bound behind backs, rest briefly during a death-dealing march from Bataan to San Fernando on the way to O'Donnell and Cabanatuan prison camps.

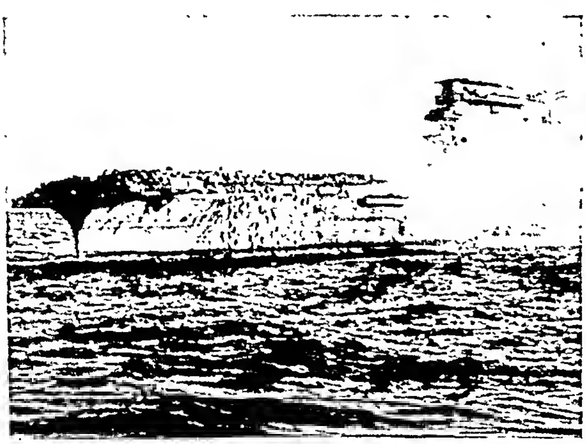
Siege of Bataan. Japanese forces landed on northern and southern Luzon Dec. 10–24, 1941. To avoid encirclement General MacArthur abandoned Manila and withdrew his troops to the rugged peninsula of Bataan Jan. 3, 1942. Here about 3,200 American and Filipino regulars and several thousand reservists held out against savage attacks until April 9. Then 36,853 exhausted defenders surrendered the peninsula. General Wainwright and others escaped to Corregidor and continued their delaying action there. But on May 6 the Japanese overran the island and captured an additional 11,574 Americans and Filipinos Later 17,200 of these prisoners died on an infamous "death march" to prison camps. United States troops engaged were the 31st Infantry and 4th Marine regiments, and National Guard units from New Mexico, California, Kentucky, Ohio, and Illinois.

Counterattacks on Sea and Land

In 1942 the American Navy defeated the Japanese fleet in the Coral Sea, at Midway, and in the Solomons. Meanwhile United States ground forces regained Guadalcanal (and later the northern Solomons) and Papua.

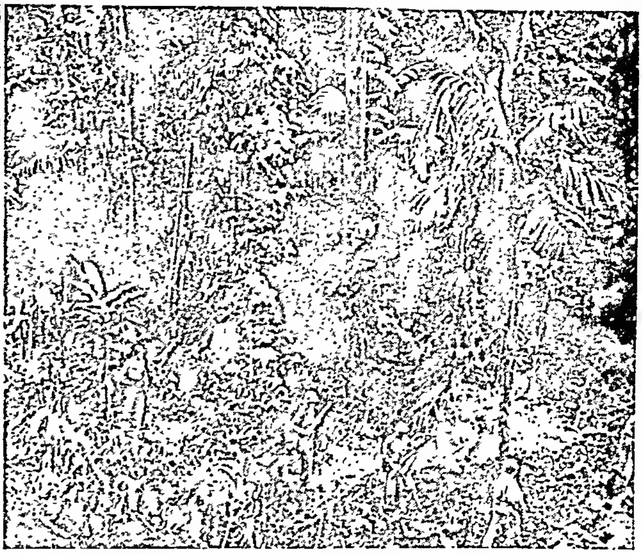
Battle of the Coral Sea. On May 4–8, 1942, an American naval task force, commanded by Admiral Fletcher, battled a Japanese invasion fleet in the Coral Sea, northeast of Australia. Surface ships did not exchange a shot; action was confined to long-range attacks by carrier planes. American planes were based on the *Lexington* and *Yorktown.* On May 8, the enemy withdrew, accepting their first setback of the war. American losses included the *Lexington*, one destroyer, one tanker, 66 planes, and 543 men. The estimated Japanese losses ran much higher.

Battle of Midway. On June 3–6, 1942, two American naval task forces and land-based planes from Midway intercepted a Japanese fleet of 88 ships west of Midway. Admiral Spruance commanded Task Force 16; Admiral Fletcher headed Task Force 17. In a pitched air-sea battle the Japanese were repulsed, losing 4 carriers, 2 heavy cruisers, 3 destroyers, and 275 planes. This decisive defeat stopped the Japanese eastward advance in the Pacific. American losses included the carrier *Yorktown*, one destroyer, 150 planes, and 307 men. In this action Torpedo Squadron 8, from the carrier *Hornet*, attacked a force of enemy carriers. All the torpedo planes were lost and only one crewman survived.



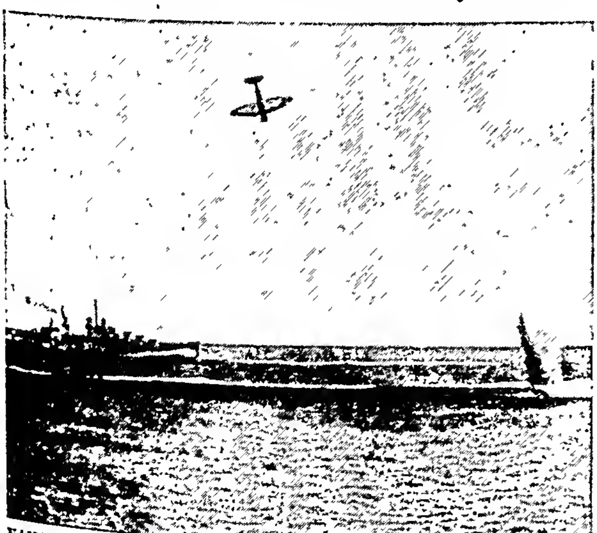
BATTLE OF THE CORAL SEA. American seamen abandon the carrier *Lexington*, knocked out by Japanese torpedoes in a savage naval engagement. Almost all the crew were saved.

BATTLE OF MIDWAY. A Japanese carrier burns furiously after attack by American torpedo planes. Two planes (which are shown by arrows) circle for another shot at their prey.



SOLOMON ISLANDS CAMPAIGN. Left, U. S. Marines tread wearily along a jungle trail on Guadalcanal. Right, an infantry patrol stalks through the dense jungles of Bougainville, feeling out Japanese positions.

Solomon Islands Campaign. On Aug. 7, 1942, the 1st Marine Division, commanded by General Vandegrift, landed on Guadalcanal and seized Henderson Field. Later reinforcements were the 2d Marine and the 25th and Americal Infantry divisions. After six months of bloody jungle warfare, the Americans wiped out the last enemy units on Feb. 8, 1943. New Georgia was taken Aug. 6, 1943, by the 37th, 43d, and 25th Infantry divisions. Bougainville was invaded Nov. 1, 1943, by the 3d Marines, later reinforced by the 37th, 93d, and Americal Infantry divisions.



NAVAL BATTLES IN THE SOLOMONS. Shot down by anti-aircraft fire from the U. S. cruiser (left), a Japanese plane splashes into the sea while a second enemy plane falls helplessly.

Naval Battles in the Solomons. In a series of five naval engagements Aug. 9–Nov. 15, 1942, the United States Navy protected the invasion of the Solomon Islands. A large portion of the Japanese fleet was destroyed but at a heavy cost in American ships. BATTLE OF SAVO ISLAND (August 9)—A Japanese night attack was repulsed, but the United States lost the cruisers *Quincy*, *Vincennes*, and *Astoria*. BATTLE OF EASTERN SOLOMONS (August 23–25)—American carrier planes forced the enemy fleet to withdraw; later actions cost the carrier *Wasp* and five destroyers. BATTLE OF CAPE ESPERANCE (October 11–12)—An American night attack again drove off the Japanese. BATTLE OF SANTA CRUZ ISLAND (October 26)—United States and Japanese carriers exchanged blows; 2 enemy carriers were sunk and about 100 planes shot down at a cost of the carrier *Hornet* and 74 American planes. BATTLE OF GUADALCANAL (November 13–15)—Japanese attacks were repulsed with heavy losses on both sides, including the American cruisers *Atlanta* and *Juneau;* the cruiser *Northampton* was sunk two weeks later off Lunga Point.

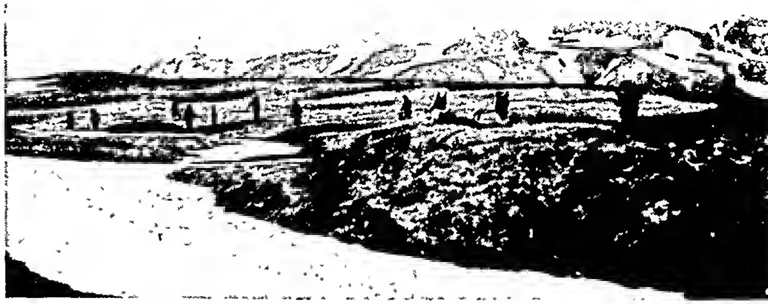
Battle of Papua. By Sept. 12, 1942, the Japanese attack in New Guinea had carried to within 30 miles of the Allied base at Port Moresby. But American and Australian troops then drove the Japanese back over the Kokoda Trail through the Owen Stanley Mountains. Fighting in jungles and swamps the Allies took Buna (Dec. 14, 1942) and Sanananda (Jan. 22, 1943) in Papua. United States divisions: 32d and 41st Infantry.

BATTLE OF PAPUA, NEW GUINEA. Infantrymen of the U. S. 32d Division fire into Japanese dugout at Buna. Each enemy emplacement had to be thoroughly searched for snipers.

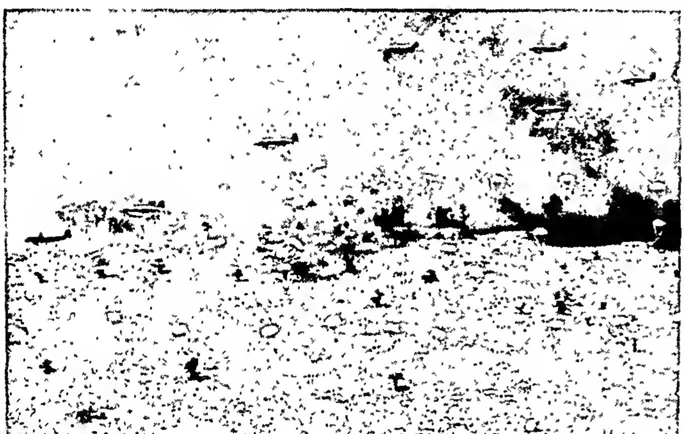
American Advance in the Pacific

THROUGHOUT 1943 and 1944 American land, sea, and air forces steadily pushed back the Japanese in the north, central, and southwest Pacific. They won decisive victories in the Aleutians, New Guinea, the Gilberts, and the Marshalls.

Battle of the Aleutians. On June 4-6, 1942, the Japanese occupied the Aleutian Islands in the farthest point of their drive toward Alaska. Almost a year later, on May 11, 1943, the United States 7th Infantry Division bypassed Kiska and stormed ashore on Attu. In bitter, hand-to-hand fighting they wiped out the entire Japanese garrison by May 31. American battle deaths were 512, while the Japanese lost 2,350 killed. Kiska was occupied without opposition Aug. 15, 1943, freeing the Aleutians.



BATTLE OF THE ALEUTIANS. Troops of the U. S. 7th Division fan out from their beachhead at Holtz Bay and attack toward Attu's fog-shrouded mountains. Despite strong defenses all the Japanese on the island were killed or captured in 21 days.



CAMPAIGN IN NEW GUINEA. Behind a smoke screen paratroopers jump from low-flying transport planes in New Guinea. Successful jumps of this type enabled the Allies to bypass many pockets of enemy resistance.

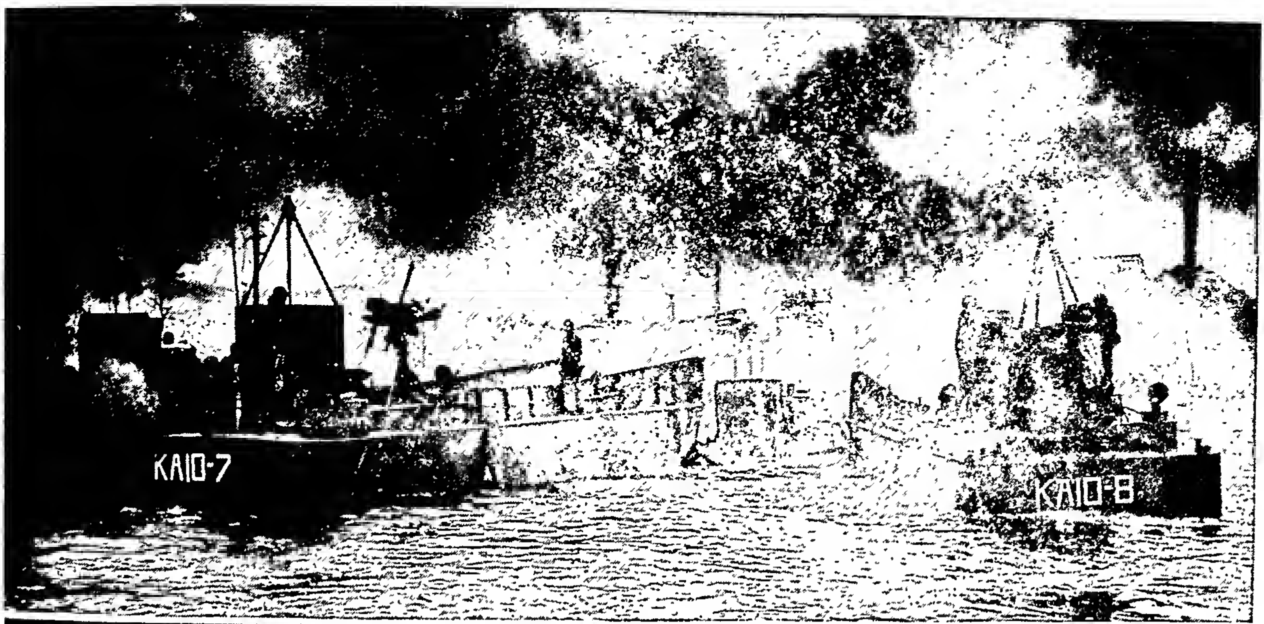
Campaign in New Guinea. From June 1943 to July 1944 General Krueger's Sixth Army leapfrogged along the northern shore of New Guinea with amphibious, air-borne, and overland attacks. This advance pushed 1,300 miles closer to Japan and bypassed 135,000 enemy troops in the southwest Pacific. United States infantry divisions and their battles: 6th (Wakde, Sansapor), 24th (Hollandia, Biak), 31st (Aitape, Wakde-Sarmi), 32d (Saidor, Aitape), 33d (Wakde-Sarmi), 41st (Salamaua, Hollandia, Aitape, Wakde, Biak), 43d (Aitape); 1st Cavalry Division (Admiralties).

Battle of the Gilberts. The seizure of the Gilberts (Operation Galvanic) opened the American advance in the central Pacific. On Nov. 21, 1943, the 2d Marine Division invaded Tarawa in the face of a murderous crossfire from heavily fortified pillboxes. The island was conquered in four days at a cost of 913 Marine dead and 2,000 wounded. The 27th Infantry Division took Makin Nov. 21–23.

Battle of the Marshalls. The invasion of the Marshall Islands (Operation Flintlock) marked the first conquest of Japanese territory. Despite bitter enemy resistance the 4th Marine Division took Namur and Roi (Jan. 31–Feb. 2, 1944), the 7th Infantry Division captured Kwajalein (Jan. 31–Feb. 5), and the 27th Infantry division overran Eniwetok (Feb. 19-22).

BATTLE OF THE GILBERTS. Under heavy enemy fire U. S. Marines crawl forward over Tarawa sand to attack Japanese gun positions further inland.

BATTLE OF THE MARSHALLS. Blasted from his blockhouse on Namur, a Japanese soldier stumbles forward to surrender while a second pokes his head out of the rubble.



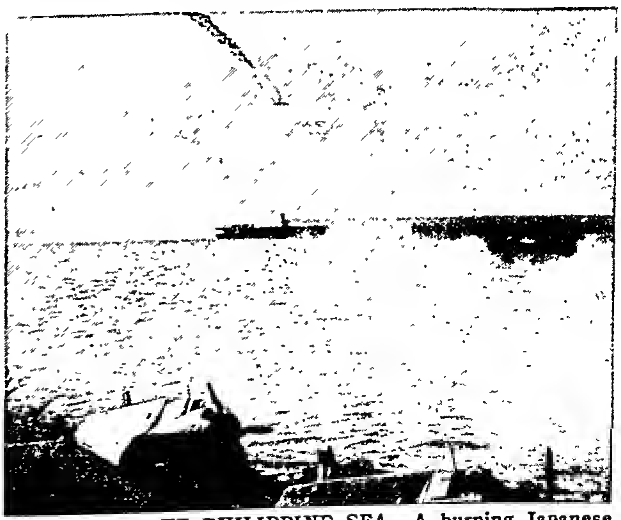
BATTLE OF THE MARIANAS. Coast Guard landing craft (top picture) maneuver through smoke from burning shore installations on Saipan. Two Marines (center and left in bottom picture) are hit by enemy sniper fire on the beach at Saipan.

Breaking Through Japan's Defenses

AFTER the battle of the Philippine Sea, the United States Navy ruled the Pacific for 3,000 miles west of Hawaii. In ground action American troops conquered the Marianas, thus neutralizing the large Japanese naval base on Truk in the Carolines. Other victories were won in the Palaus and in Burma. Only in China did the enemy escape the unrelenting American pressure. And here the Japanese were subjected to savage air attacks from the 10th and 14th Air Forces.

Battle of the Marianas. Supported by Admiral Spruance's Third Fleet, American ground troops assaulted the Marianas in Operation Forager. On June 15, 1944, the 2d and 4th Marine divisions invaded Saipan, followed the next day by the 27th Infantry Division. The Japanese resisted savagely with machine guns, small arms, and light mortars emplaced in caves and concrete pillboxes. The last desperate *banzai* charge was smashed July 7 and all organized opposition ceased two days later. On July 21 the 77th Infantry and the 3d Marine divisions stormed ashore on Guam and overran that island by August 10. Tinian was taken by the 2d and 4th Marine divisions (July 24–August 1). On Nov. 24, 1944, B-29 Superfortresses delivered their first major strike against Japan from bases on Guam and Saipan.

Battle of the Philippine Sea. The United States invasion of Saipan provoked the Japanese navy to counterattack. On June 19, American planes from 15 carriers of Admiral Mitscher's Task Force 58 destroyed 402 enemy aircraft. Four United States ships suffered minor damage and 17 planes were lost. The following day American carrier planes located the Japanese fleet farther to the west. They destroyed about 300 more enemy planes and sank 2 carriers, 2 destroyers, and one tanker, and crippled 11 other vessels. Enemy antiaircraft fire and hostile fighter planes shot down 16 American aircraft. An additional 73 planes were lost in the water when the pilots could not locate their carriers after dark, but 65 of the pilots were rescued.



BATTLE OF THE PHILIPPINE SEA. A burning Japanese plane vainly tries to crash dive a U. S. escort carrier. The deck of another U. S. carrier shows in the immediate foreground.

BATTLE OF BURMA. Landed in northern Burma by parachutes and gliders, these troops of Merrill's Marauders push forward along a jungle trail despite Japanese sniper and artillery fire.

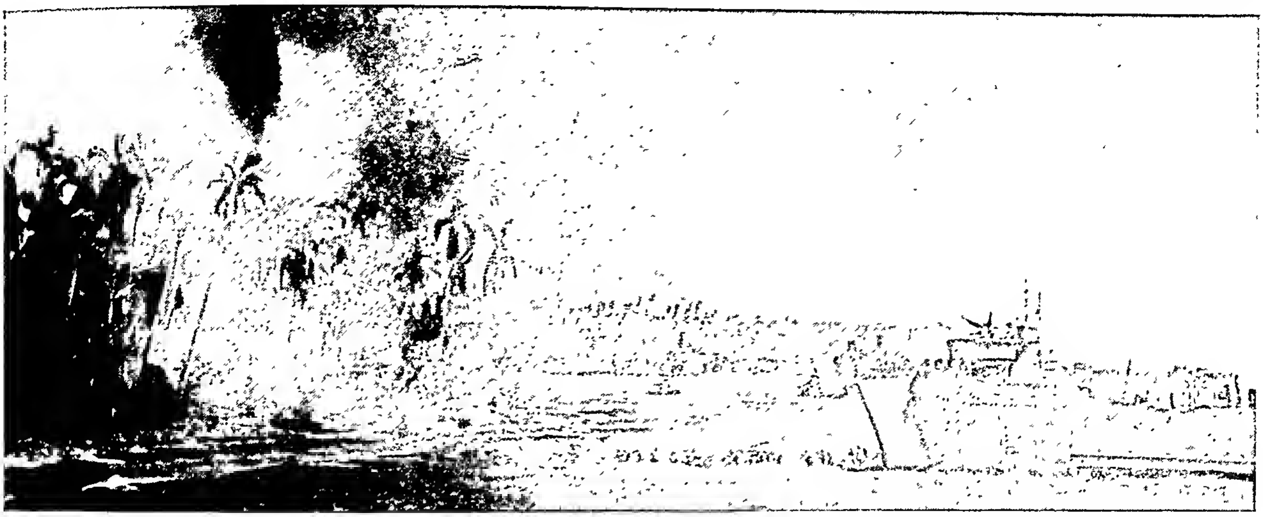
BATTLE OF THE PALAUS. U. S. Marines of the 1st Division storm ashore at Peleliu, chief Japanese stronghold in the Palaus. Note the U. S. amphibious tractor burning in the background.

Battle of Burma. The Japanese conquest of Burma in the spring of 1942 cut the only Allied ground route to China. This route ran by rail from Rangoon to Lashio and then over the Burma Road to Kunming. In the fall of 1943 the Allies launched Operation Capital to reopen a road into China. Advancing from Assam, India, two American-trained Chinese divisions drove down the Hukawng Valley in northern Burma (October 1943). In the rear of the attacking Chinese United States engineers blasted out the new Ledo Road (later called Stilwell Road). This route extended to the old Burma Road at Mongyu. In February 1944 the Chinese were reinforced by Merrill's Marauders, a specially selected combat team landed by parachutes and gliders. The southern flank of the advance was protected by a force of British Chindits known as Wingate's Raiders. On August 3, 1944, the veteran Allied jungle fighters captured Myitkyina. They cleared the way to Mongyu by January 1945.

Battle of the Palaus. On Sept. 15, 1944, the 1st Marine Division secured a beachhead on Peleliu Island in the Palau group. By the following night the important airstrip had been captured, but thereafter progress was slow. The chief obstacle was a rough ridge (later called "Bloody Nose Ridge") which formed the backbone of the island. The Japanese defended this natural fortress with mortars and automatic weapons. On September 22 a combat team of the 81st Infantry Division reinforced the marines. Enemy forces were surrounded four days later but held out until mid-October. Six miles south of Peleliu the remainder of the 81st Division took the island of Angaur (September 17–20). Meanwhile on September 15 the 31st and 32d Infantry divisions seized Morotai, 350 miles south of the Philippines.

Battle of China. The Japanese attack on China, begun in 1937, was intensified late in 1944 in an effort to wipe out forward bases of the United States 14th Air Force. From Sept. 8 to Nov. 26, 1944, seven large air bases were overrun by the Japanese. Less than a month later, enemy columns had split unoccupied China, opening up a Japanese-dominated route from Malaya north to Korea. By the spring of 1945, however, the Chinese launched a counteroffensive which regained much of the territory lost the previous year. Important elements in this drive were 35 divisions that General Stilwell had helped train and equip. Air support was provided by the 14th Air Force based at Kunming, and the 10th Air Force brought from India to Luichow.

BATTLE OF CHINA. American-trained Chinese troops use a flame thrower to sear a Japanese strong point at Tengchung, China. The first city on the eastern side of Burma to be recaptured, Tengchung fell after a bloody five-weeks' siege.



BATTLE OF LEYTE. Landing craft disgorge U. S. infantrymen onto a beach that still smoulders from pounding by naval gunfire and air bombardment. Recapture of Leyte by the American Sixth Army marked the first step in the liberation of the Philippine Islands, lost to the Japanese in 1942.

Winning Back the Philippine Islands

BY THE fall of 1944 the United States drives across the central and southwest Pacific had provided bases for full-scale attack aimed at liberating the Philippine Islands. As a preliminary to landing operations, American planes virtually swept Japanese aircraft from the skies. In September alone carrier planes from Admiral Halsey's Third Fleet destroyed almost 2,000 enemy aircraft.

Battle of Leyte. On Oct. 20, 1944, the United States Sixth Army swarmed ashore on the east coast of Leyte. The X Corps (24th Infantry and 1st Cavalry divisions) landed south of Tacloban while the XXIV Corps (7th and 96th Infantry divisions) invaded near Dulag. The two beachheads were joined four days later. But Japanese resistance remained firm as the enemy brought in three fresh divisions through the port of Ormoc. To speed the American advance the 32d Infantry Division reinforced the X Corps while the 77th made a surprise landing south of Ormoc and captured that city four days later, December 11. Meanwhile Japanese paratroops landed near Tacloban (December 7) but were quickly wiped out by the 11th Airborne Division. Organized enemy resistance ended Dec. 26, 1944, but mopping-up operations (assisted by the Americal Infantry Division) continued for many weeks. Japanese losses on Leyte were 54,833 killed and 493 captured. American losses were 2,623 killed, 8,422 wounded, and 172 missing. Meanwhile elements of the 1st Cavalry Division invaded Samar (October 30) and a combat team from the 24th Infantry Division and the 503d Parachute Regiment landed on the island of Mindoro.

Battles of Leyte Gulf. Japanese naval forces challenged the Leyte landings in a series of three engagements Oct. 23–26, 1944. BATTLE OF SURIGAO STRAIT—one enemy force of seven ships approached Leyte from the south. On October 24 Admiral Kinkaid's Seventh Fleet destroyed two battleships and three destroyers; a cruiser was sunk two days later. BATTLE OFF SAMAR—a central force of 26 Japanese ships brushed aside air attacks of Third Fleet carrier planes

BATTLES OF LEYTE GULF (Second Battle of the Philippine Sea). Shot down by antiaircraft fire, a Japanese plane burns on the sea as a U. S. carrier (*Independence* class) maneuvers to avoid other enemy plane attacks. During these engagements the Japanese navy suffered a decisive defeat at the hands of the American Third and Seventh Fleets.

and moved through San Bernardino Strait. They hit at Seventh Fleet escort carriers October 25. Ten enemy vessels were sunk at a cost of two American destroyers, one destroyer escort, and two escort carriers. BATTLE OFF CAPE ENGAÑO—a third enemy force of 17 ships approached from the north. It was driven back by Admiral Mitscher's Task Force 38 of the Third Fleet with a known loss of five vessels October 25. About 110 Japanese land-based planes were shot down during these battles. The Seventh Fleet lost 105 carrier planes, the Third Fleet lost 40 carrier planes and the carrier *Princeton*.

BATTLE OF LUZON. U. S. infantrymen stride through ruins of Manila against a fanatical Japanese last stand in the old, walled city. American troops entered Manila Feb. 4, 1945, but the Japanese resisted until February 23.

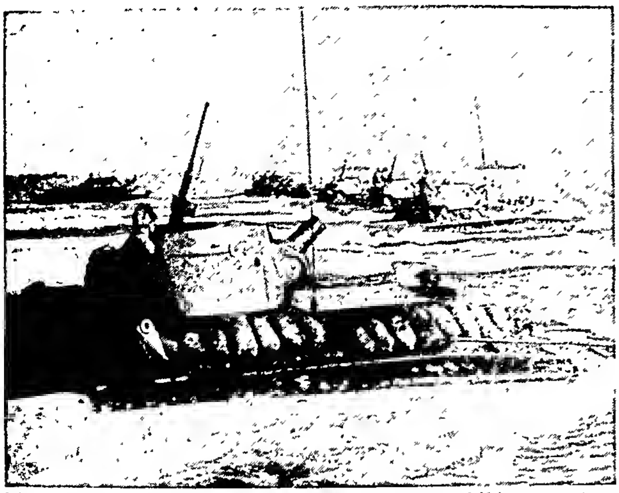
Battle of Luzon. On Jan. 9, 1945, General Krueger's Sixth Army stormed ashore at Lingayen Gulf. The Eighth Army, commanded by General Eichelberger, landed at Subic Bay January 29 and at Batangas two days later. These attacks trapped the Japanese in a giant pincers, but they fought back savagely in Manila, at Balete Pass, and in the Cagayan Valley. Organized resistance ceased June 28 but sizable pockets held out for months later. American prisoners were freed at Santo Tomás, Cabanatuan, Los Baños, and Baguio. United States divisions: 6th, 25th, 32d, 33d, 37th, 38th, 40th, 43d Infantry, 1st Cavalry, and 11th Airborne.

Final Victories in the Pacific

By 1945 successful steppingstone operations had carried American forces to Japan's innermost defenses. Then decisive victories at Iwo Jima and Okinawa and the atomic bomb forced Japan to surrender.

Battle of Iwo Jima. Directly in the path of B-29's based on the Marianas lay the Japanese fighter base at Iwo Jima. To remove this menace the V Marine Corps (4th, 5th, and later the 3d divisions) commanded by General H. Smith invaded the island Feb. 19, 1945. After desperate fighting it was conquered March 16. United States losses: 4,189 killed, 15,308 wounded, 441 missing. Japanese: 22,000 killed and captured.

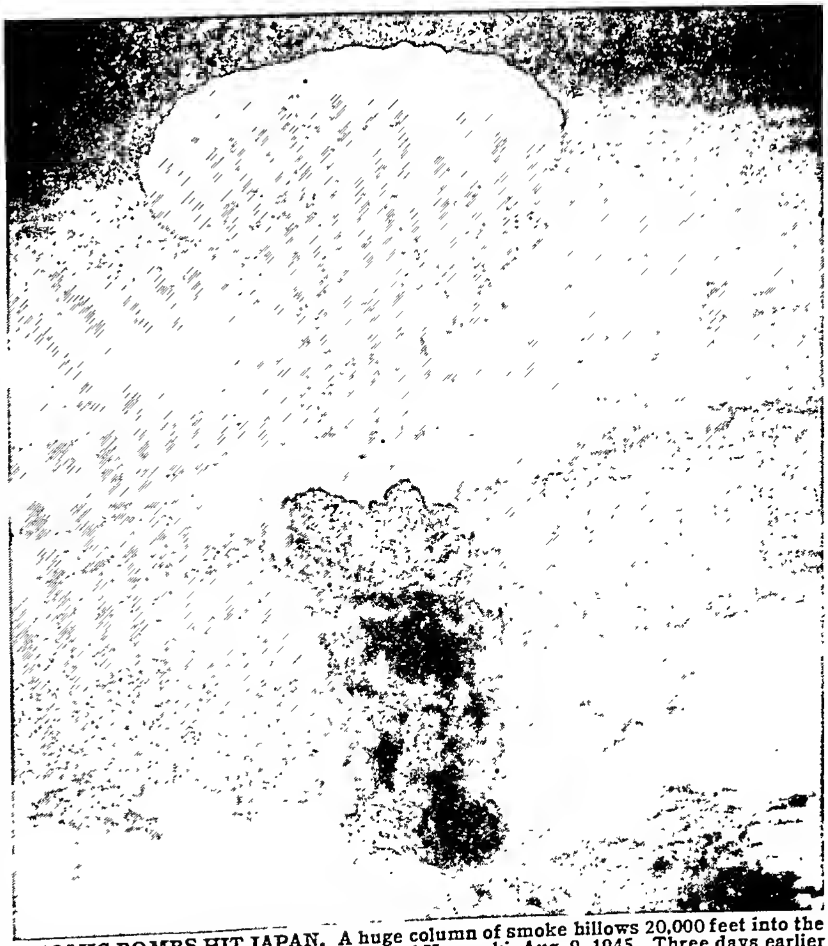
BATTLE OF IWO JIMA. Left, U. S. Marines burrow in the volcanic sand of the beach to escape hail of enemy fire from gun positions on Mount Suribachi (background). Right, two marines use flame throwers to turn a Japanese pillbox into a scorching inferno.



BATTLE OF OKINAWA. Left, U. S. Marine amphibious tractors, ballasted by sandbags, group in waves for a dash to the Okinawa beach on D-Day, April 1, 1945. Right, as smoke from explosion of a "satchel charge" spirals overhead, combat veterans of the U. S. 1st Marine Division close in for point-blank firing at Japanese holed up in a cave.

Battle of Okinawa. To tighten the blockade against Japan, General Buckner's Tenth Army landed along the western coast of Okinawa April 1, 1945. After driving across the narrow width of the island the III Marine Corps swung to the left. Meanwhile the XXIV Army Corps turned to the south. Here strong enemy defenses were constructed around blockhouses, pillboxes, and caves protected by double-apron barbed wire and mine fields. After mopping up the northern end of the island the Marines took over a sector in the south to assist attacks against the Naha and Shuri lines. This Army-Marine force advanced 14 miles to the southern tip of the island only after 79 days of bitter fighting. Organized resistance ceased June 21. Infantry divisions were: 7th, 27th, 77th, 96th. Marine divisions were: 1st, 6th (2d in reserve) and a combat team. Japanese losses were 109,629 killed and 7,871 captured; American casualties totaled 39,000, including 10,000 naval personnel of the supporting Fifth Fleet. This fleet was constantly assaulted by Japanese planes in *Kamikaze* (suicide) attacks. In the Okinawan operation, 3,400 enemy planes were shot down and 800 destroyed on the ground. United States losses totaled about 1,000 aircraft, 35 ships sunk, and 45 damaged, chiefly from aerial attacks.

Atomic Bombs Hit Japan. During July 1945 B-29 Superfortresses from the Marianas averaged 1,200 sorties a week against the Japanese homeland. Other planes from Okinawa and Iwo Jima joined in the aerial assault. Meanwhile the Third Fleet sailed boldly into enemy coastal waters and hammered targets with its guns and planes. Then on August 6 an atomic bomb was dropped on Hiroshima, shattering about three-fifths of the city. A second atomic bomb hit Nagasaki three days later causing even greater destruction. Russia entered the war August 8 and attacked the Japanese in Manchuria. On Aug. 10, 1945, Japan sued for peace and agreed to surrender terms on the 15th. (This date was August 14 in the United States.)



ATOMIC BOMBS HIT JAPAN. A huge column of smoke billows 20,000 feet into the air as an atomic bomb blasts the seaport of Nagasaki, Aug. 9, 1945. Three days earlier another atomic bomb had shattered the Japanese military base at Hiroshima.

Stupendous Consequences of the War

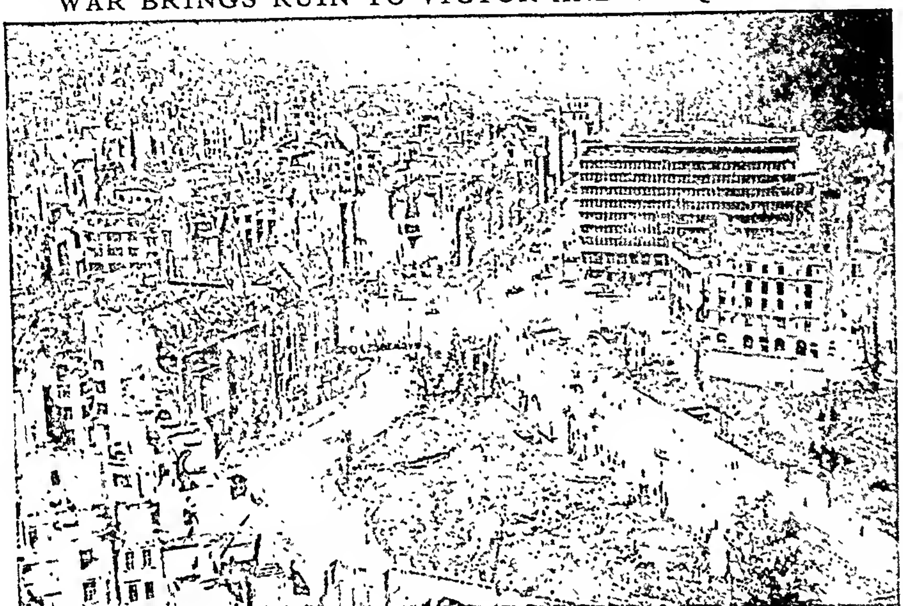
WHEN hostilities ceased, people everywhere faced their future in a world horribly ravaged by war. Many of the victorious nations had suffered almost as much as the vanquished.

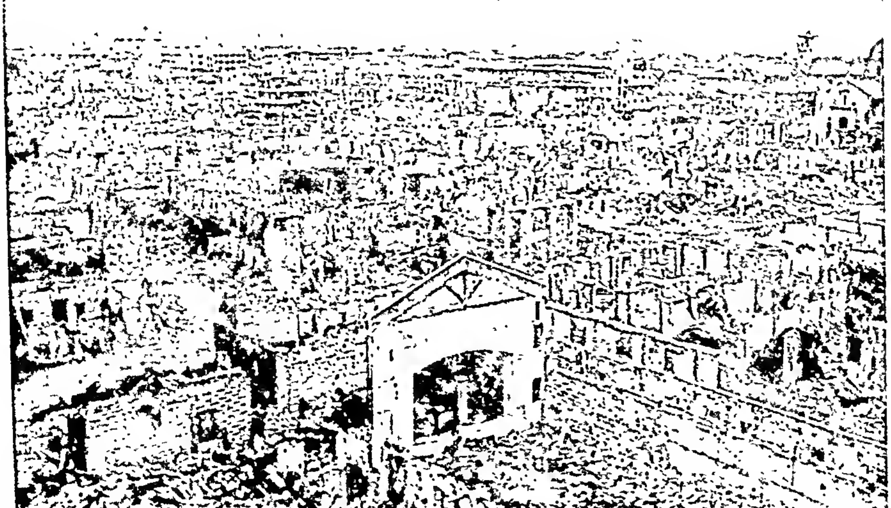
Western Russia and Poland had been ravaged as completely as Germany. England, France, and the Netherlands were as battered as Italy. In China and the Philippines, the losses matched those in Japan. The losses in life, money, resources, and production exceeded the visible damage to buildings and land; and throughout Europe and eastern Asia wholesale death by famine and disease threatened the surviving population.

The Cost in Human Life

No one will ever know what the war cost in killed, permanently disabled, and wounded. Many nations, victors as well as vanquished, could not accurately count their losses. Germany and Japan also concealed the results of wholesale massacres. But the known figures are sufficiently appalling.

WAR BRINGS RUIN TO VICTOR AND VANQUISHED





These air views show only a part of the terrible havoc suffered by both sides in the second World War. Large cities were particularly hard hit because they were important bombing targets as well as major centers of resistance in ground combat. Top, German government buildings around Potsdamer Platz in Berlin were blasted beyond repair by Allied bombers. Bottom, Japanese demolitions and savage house-to-house fighting made a shambles of Manila.

As the table on the next page shows, the military forces of the Allies and the Axis lost a total of about 14½ million killed. This compares with wiping out the population of all New England, New Jersey, Delaware, and Maryland. If the wounded are estimated in the same proportion as in the first World War, and are added to the number killed, the casualties would almost equal the population of the above states plus New York, Pennsylvania, Virginia, North Carolina, South Carolina, Georgia, and Florida.

In the second World War, the civilian population suffered even more than the military forces through air bombing, starvation, epidemics, and deliberate massacre. Estimated losses amount to almost 13 million killed, without allowance for deaths in China and other parts of eastern Asia. To cover this loss, we would have to add Alabama, Tennessee, Kentucky, West Virginia, and half of Ohio to the states already named. Some outstanding losses were: Russia, 6,000,000; Poland, 5,000,000; Germany, 500,000; France, 450,000; Greece, 380,000; Japan, 250,000.

The Cost in Money

As shown on a later page, total military expenditures amounted to more than 1 trillion dol-

lars (a million millions). Property damage has been estimated at almost as much (800 billion dollars). As part of the damage, the war at sea cost 4,770 merchant vessels, with a gross tonnage of more than 21 million. This amounted to 27 per cent of all the vessels in existence at the start of the war.

Moreover, war spending did not stop when the fighting ended. Care of the maimed and disabled, pensions, and other expenses will continue for a generation. The experience of the United States after the first World War indicates how expenditures will continue. In the United States it was expected that disbursements for United Nations relief, occupation of foreign countries, and veterans would raise the total cost of the war by another 30 billion dollars.

FIGURES ON THE AMERICAN WAR EFFORT

Armed Forces Strength:	_Start of War_	_Peak_
Army	1,600,000	8,300,000
Navy	293,000	3,300,000
Marines	64,000	590,000
Army Air Forces—		
Men	210,000	2,400,000
Planes	2,500	80,000
Women in Armed Forces	....	315,000
Merchant Marine—		
Men	55,000	270,000
Ships	11,000,000 tons	60,000,000 tons

Casualties:	_Killed_	_Wounded_	_Missing_
Army	234,874	565,861	.....
Navy	39,379	37,778	.....
Marine Corps	19,733	67,207	.....
Merchant Marine	810	....	4,826

War bond sales—$227,000,000,000
Lend-lease aid—$46,000,000,000
Direct military cost of war—$318,000,000,000

Losses in Normal Production

We should also count as loss what the people of the world might have produced if they had not been engaged in war. Although the figures in terms of money are impossible to determine, we can get an idea of what it might have been from the number of people engaged in war. The number of people under arms has been estimated at about 92 million. Figures for specific nations are: Russia, 22 million; Germany, 17 million; United States, 14 million; Great Britain, 12 million. In 1943, the war year of peak employment in the United States, an additional 12,601,000 people worked in the basic war industries alone. In many other countries virtually every worker had a war job. The world lost years of peacetime production from all these people.

This loss to industry, moreover, did not cease with the end of the war. Millions of people were not only torn from normal production, but they could not return to their usual work. Millions could not go back to jobs because factories, railroads, and other facilities had been destroyed. Millions of others had lost the money they needed, or their business had been destroyed by war.

BATTLE CASUALTIES IN THE TWO WORLD WARS

Country	Killed and Died		Wounded		Prisoners and Missing	
	World War I	World War II	World War I	World War II	World War I	World War II
Austria-Hungary	_1,200,000_	....	_3,620,000_	....	_2,200,000_	....
Belgium	13,716	7,760	44,686	*	34,659	70,000
British Empire	908,371	353,652	2,090,212	475,070	191,652	417,303
Bulgaria	_87,500_	*	_152,390_	*	_27,029_	*
China	....	1,310,224♦	....	1,752,591♦	....	115,248♦¶
Finland	....	_52,609_	....	_125,000_	....	*
France	1,357,800	166,195	4,266,000	408,895	537,000	1,500,000‡
Germany	_1,773,700_	_3,250,000_	_4,216,058_	_4,000,000_	_1,152,800_	_11,741,000_
Greece	5,000	77,200	21,000	*	1,000	*
Holland	....	6,238	....	20,000†	....	25,000†
Hungary	....	_75,000_†	....	*	....	*
Italy	650,000	_60,000_‖	947,000	* ‖	600,000	_700,000_‖
Japan	300	_1,862,499_	907	_4,616,000_	3	_685,464_‡
Montenegro	3,000	....	10,000	....	7,000	....
Norway	....	1,000†	....	*	....	*
Poland	....	125,000†	....	141,000†	....	542,000†
Portugal	7,222	....	13,751	....	12,318	....
Rumania	335,706	_80,000_	120,000	*	80,000	_594,000_‡
Russia	1,700,000	6,750,000†	4,950,000	*	2,500,000	*
Serbia	45,000	....	133,148	....	152,958	....
Turkey	_325,000_	....	_400,000_	....	_250,000_	....
United States	53,407	293,986	204,002	670,846	§	§
Yugoslavia	....	75,000†	....	*	....	125,000‡
Total for Allies	5,152,115	9,186,111	12,831,004	....	4,121,090	....
Total for Central Powers or Axis	_3,386,200_	_5,380,108_	_8,338,448_	....	_3,629,829_	....

Casualties of countries belonging to the Central Powers in World War I or to the Axis Powers in World War II are shown in italic type. *No reliable figure available. †Broadly estimated. ‡Prisoners only. §All such personnel now officially accounted for. ♦Chinese casualties are for 1937-45. ¶Missing only. ‖Italian casualties on Allied side were 69,774 killed, 76,610 wounded, and 17,647 missing.

Furthermore, many millions had lost hope and the will to work. This attitude could easily become a universal menace in the years to come, unless hope could be rekindled by improved conditions.

Social and Political Unrest

The situation can be made plain by looking at the future as millions of people saw it. They saw their country shattered and knew that rebuilding would take many years. If the country tried to meet the expense through taxes and increased prices for goods, the cost would impoverish the people the rest of their lives.

With such a prospect before them, people in many nations willingly listened to agitators who urged letting a dictatorship rebuild the country. In many countries the people had become demoralized. For years, they had bought supplies in "black markets," and had taken any means to get enough food to live. After the war, their governments could not find ample food or clothing to meet the needs for mere existence; so abnormal ways of life continued and greatly hampered recovery of production, business, and normal government.

DIRECT COST OF THE TWO WORLD WARS

Country	First World War to 1919*	Second World War to V-J Day
United States and Allied Powers		
United States	$27,729,000,000	$317,600,000,000
Russia	22,593,950,000	192,000,000,000†
British Empire		
Great Britain	44,029,012,000	120,000,000,000
Canada	1,665,576,000	15,680,000,000
Australia	1,437,419,000	6,500,000,000
New Zealand	378,750,000	165,000,000
South Africa	300,000,000	§
India	601,279,000	2,145,000,000‡
France	25,812,783,000	97,940,000,000
Belgium	1,154,467,000	3,250,000,000
Serbia	399,400,000	See Yugoslavia below
Yugoslavia	See Serbia above	220,000,000
Greece	270,000,000	220,000,000
China	§	§
Italy	12,313,998,000	Axis power (see below)
Japan	40,000,000	Axis power (see below)
Rumania	1,600,000,000	Axis power (see below)
Netherlands	Not engaged	1,000,000,000
Norway	Not engaged	93,000,000
Poland	Not a nation	2,000,000,000
Czechoslovakia	Not a nation	1,500,000,000
South American nations		9,278,000,000
Total	$140,325,634,000	$676,079,400,000
Germany and Associated Powers		
Germany	$37,775,000,000	$272,900,000,000
Austria-Hungary	20,622,960,000	§
Bulgaria	815,000,000	§
Italy	Allied power (see above)	94,000,000,000
Japan	Allied power (see above)	56,000,000,000
Rumania	Allied power (see above)	§
Turkey	1,430,000,000	Not engaged
Total	$60,642,960,000	$422,900,000,000
Grand Total	$200,968,594,000	$1,192,491,000,000

*Congressional Record, April 14, 1932. †Russia estimated cost at $485,000,000,000. ‡Through 1943 only. §No authoritative figures available.

Gains in Science and Technology

In contrast to this grim record and outlook, the world had gained remarkable advances in science and methods of manufacture. Nations, in order to win advantages over their enemies, had achieved more progress than they would have ordinarily.

In many fields of industry, manufacturing methods had been transformed. Automatic methods and machinery replaced costly handwork in countless operations. Machines were developed to squeeze and mold metal like putty. New alloys and plastics were developed at tremendous cost, but were available thereafter at low cost. Aluminum, for example, was plentiful for use in the postwar world. New magnesium alloys were available to lighten the weight of engines and many machines and structures.

Medicine and surgery achieved notable advances in treating injuries and controlling or curing tropical diseases. Penicillin might not have been produced for a generation in normal times; but it was developed speedily at a cost of millions of dollars. War insecticides such as DDT promised a new era in controlling dangerous pests and disease carriers.

Development of jet and rocket propulsion offered prospects of air transportation at the speed of sound (about 720 miles an hour). The greatest advance of all was the unleashing of atomic power. It came in the deadly, menacing form of atomic bombs; but peacetime benefits could be incalculable.

Thus, in many ways, these advances could balance loss and misery, if men succeeded in restoring order and the spirit of progress. These conflicting prospects provided a challenging background for efforts to establish a lasting peace in the world.

The Hard Road to Peace

THROUGHOUT the years of fighting, the postwar state of the world was taking shape, both from the course of the war itself and from agreements made between the heads of governments.

A stirring prospect for brighter days was offered early in the war when President Roosevelt and Prime Minister Churchill met at sea off the North American coast in August 1941. The two leaders produced a historic declaration known as the "Atlantic Charter," with eight principles "on which they based their hopes for a better future for the world":

First, their countries seek no aggrandizement, territorial or other;

Second, they desire to see no territorial changes that do not accord with the freely expressed wishes of the peoples concerned;

Third, they respect the right of all peoples to choose the form of government under which they will live; and they wish to see sovereign rights and self-government restored to those who have been forcibly deprived of them;

Fourth, they will endeavor, with due respect for their existing obligations, to further the enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity;

Fifth, they desire to bring about the fullest collaboration between all nations in the economic field with the object of securing, for all, improved labor standards, economic adjustment, and social security;

Sixth, after the final destruction of the Nazi tyranny, they hope to see established a peace which will afford to all nations the means of dwelling in safety within their own boundaries, and which will afford assurance that all the men in all the lands may live out their lives in freedom from fear and want;

Seventh, such a peace should enable all men to traverse the high seas and oceans without hindrance;

Eighth, they believe that all of the nations of the world, for realistic as well as spiritual reasons, must come to the abandonment of the use of force. Since no future peace can be maintained if land, sea, or air armaments continue to be employed by nations which threaten, or may threaten, aggression outside of their frontiers, they believe, pending the establishment of a wider and permanent system of general security, that the disarmament of such nations is essential. They will likewise aid and encourage all other practicable measures which will lighten for peace-loving peoples the crushing burden of armaments.

In 1943 President Roosevelt and Prime Minister Churchill met at Casablanca January 14–26, in Washington in August, and at Quebec August 11–24. In 1943, at Moscow, the foreign ministers of Britain, Russia, and China, and Secretary of State Hull of the United States signed a pact to plan an international organization for peace.

President Roosevelt and Prime Minister Churchill conferred with Chiang Kai-shek of China at Cairo, Egypt, Nov. 22–25, 1943. The three agreed:

1. Japan must give up all the conquests it had gained by aggression since 1853;
2. Manchuria, Formosa, and all other territories taken from China must be restored to the Chinese;
3. Korea must be made a free and independent state.

The Tehran Conference and UNRRA

From Cairo, Roosevelt and Churchill went at once to Tehran in Iran to confer with Premier Joseph Stalin from November 28 through December 1. Although no detailed agreements were announced then, the opening of a second front in France was promised to Russia at this time. Other fruits of the meeting became apparent later in various acts.

In January 1944, Russia announced its intention to place the Soviet-Polish border along the Curzon Line, suggested by Lord Curzon in 1919. The Polish government in exile protested bitterly, but it received no support from Britain or the United States. Another agreement seemed reflected when Russia omitted Greece from its sweep through the Balkans later in 1944.

In 1943 the Allied nations took action to organize relief from the vast damage being done by the war. From November 9 to December 1, representatives of 44 nations met in Washington, D.C., and Atlantic City, N.J., and set up the United Nations Relief and Rehabilitation Administration (UNRRA). They chose as director-general former Governor Herbert H. Lehman of New York, who had headed the American Office of Foreign Relief and Rehabilitation.

It was estimated that European countries in the first six months after the war would need approximately 46 million tons of food, seed, fuel, clothing, medical supplies, raw materials and machinery. In addition there were millions of "displaced persons" who would have to be cared for as soon as the fighting ended.

The payment plan for UNRRA called for assessing the participating nations a certain percentage of their national income. The total fund would amount to about 2 billion dollars of which the United States would furnish 1 billion 350 million dollars. On March 22, 1944, Congress authorized that amount as the American contribution.

Planning Finance and World Peace

During 1944, plans were pushed for stabilizing world currencies and finance after the war, providing credit for reconstruction, and devising an international organization to preserve peace.

In a conference held during July 1944 at Bretton Woods, N. H., monetary experts of the United Nations agreed on a system for setting up an international lending agency to promote stabilization in foreign exchange dealings. Under the plan a fund would be established amounting to 8 billion 800 million dollars. Of this amount the United States was to subscribe 2¾ billion dollars; Great Britain, 1 billion 300 million; Russia, 1 billion 200 million; China, 550 million; and the other nations were to contribute lesser amounts, with quotas ranging from 450 million dollars down to 500 thousand dollars. Countries in need of funds to finance international trade could borrow an amount equal to their contribution.

The plan also called for an International Bank for Reconstruction and Development to lend money for rehabilitation projects in member nations. As with the stabilization fund, the United States would contribute the largest share to this world bank.

On Aug. 21, 1944, representatives of the United States, Russia, Great Britain, and China had met at Dumbarton Oaks estate in Washington, D. C., to draw up preliminary plans for assuring peace. The discussions were held in two separate sessions so that Russia and China were not present at the same meeting. This precaution was taken because at that time Russia was not at war with Japan, and Russian diplomats wished to be excluded from discussions relating to the Pacific. The deliberations closed October 7, and two days later the results of the parley were announced. They provided a basis for organization of the United Nations the following year.

The Momentous Yalta Conference

By the end of 1944, an Allied victory was certain and imminent in the case of Germany. Accordingly, President Roosevelt and Churchill met with Stalin at Yalta, a Russian town in the Crimea, Feb. 4–12, 1945. The conference gave Russia almost half of prewar Poland and arranged for separate zones of occupation in Germany. To induce Russia to enter the war against Japan, Stalin was secretly promised the Kuril Islands and the southern half of Sakhalin, as well as effective control of Manchuria.

ALLIED LEADERS AGREE ON WAR AIMS

From left to right are Premier Stalin, President Roosevelt, and Prime Minister Churchill at the close of their 1943 conference at Tehran, Iran. This meeting was the start of personal collaboration between the three leaders. It crystallized the Allies' plans and objectives in the war against Nazi Germany.

Within a month thereafter, the attitude of the Latin American nations was further clarified. Throughout the war, most of the Latin republics had stood solidly behind the United States. The lone exception was Argentina, where Juan Perón (dictator and later president) and his party were accused of Nazi sympathies and Nazi policies. On February 21, delegates of 20 American republics met in Mexico City as the Inter-American Conference on Problems of War and Peace. On March 3, 1945, the conference adopted the Act of Chapultepec, binding the republics to mutual action. In order that Argentina too might join its sister republics in the United Nations, it reluctantly declared war on March 27. (*See also* Latin America.)

Death of President Roosevelt

Soon afterward the shaping of postwar policy was shaken by the sudden death of President Roosevelt on April 12. Vice-president Truman succeeded to the presidency on the same day, and he announced adherence to the Roosevelt policies. The nation also showed complete willingness to support its new leader in the emergency.

For a time, other nations doubted that the United States would continue its policy of lending active aid in world affairs after the war should end. But these doubts were dissipated in some measure by the support given to formation of the United Nations.

Organization of the United Nations

At Yalta, the leaders had agreed to give effect to the proposals made at Dumbarton Oaks. On April 25, 1945, delegates from 50 United Nations assembled in San Francisco to do so. The American delegation was led by Edward R. Stettinius, Jr., the British by Foreign Secretary Anthony Eden, and the Russian by Foreign Minister Molotov.

Almost all the participating nations wanted changes made in the original Dumbarton Oaks proposals. The smaller nations wanted a larger voice in the world organization's General Assembly. Russia demanded and won admission of the Ukraine and White Russia to the Assembly in addition to the membership held by the Soviet Union. Russia also obtained a provision that any permanent member of the organization's Security Council could veto any action, even against itself.

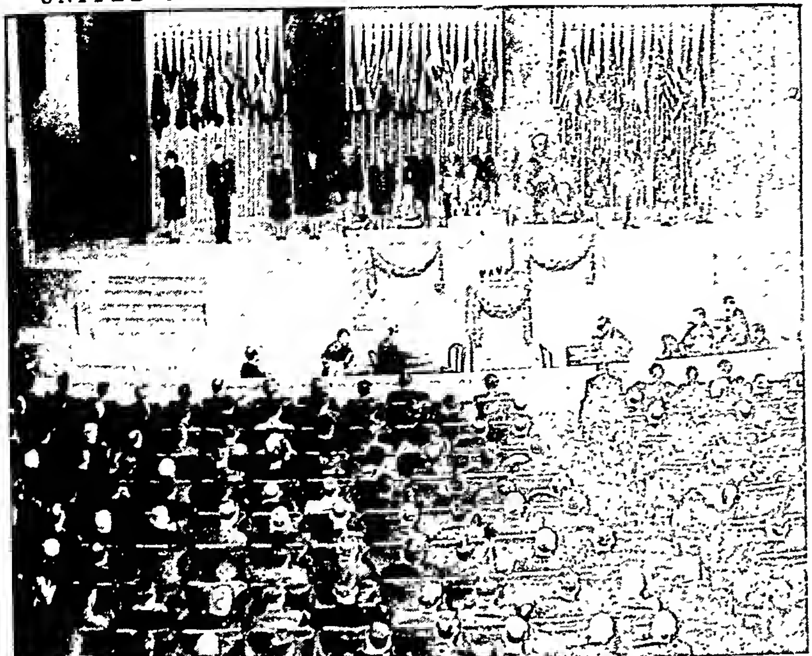
On June 26 the world security conference approved the charter of the United Nations. In the United States the charter was approved July 28, 1945, by a Senate vote of 89 to 2 after a lengthy debate. (*See also* United Nations.)

Meantime the long-disputed "Polish question" was finally settled June 28 when a "unity" cabinet of the provisional Polish government—which gained the approval of the United States, Great Britain, and Russia—was formed. And on July 5, Washington and London recognized the new Warsaw régime, thereby abandoning the Polish exile government.

Allied Leaders Confer at Potsdam

From July 17 to Aug. 2, 1945, President Truman, Premier Stalin, and Prime Minister Churchill met at Potsdam, a suburb of Berlin, to draw up plans for reconstructing Europe and for dealing with defeated Germany. (In the midst of their deliberations an election in England elevated the Labor party to power; and that party's leader, Clement R. Attlee, succeeded Churchill as prime minister.) The principal agreements were: to establish a council to prepare

UNITED NATIONS' CONFERENCE CONVENES



This is a view of the opening session of the world security conference in San Francisco. With the grouped flags of the United Nations and a line of young American servicemen and women forming an impressive backdrop, United States Secretary of State Stettinius welcomes the delegates from the stage of the Opera House.

for an eventual peace conference with Germany; to divide East Prussia between Russia and Poland and to allow Poland to annex Germany's eastern provinces; and to exact reparations from Germany for "loss and suffering" incurred by the Allies. But sharp divergencies in policy also appeared and heralded the end of wartime solidarity.

Rise of Postwar Dissension

JAPAN'S surrender brought a world-wide wave of relief. But it also unleashed the usual aftermath of dissension and striving for postwar advantages. The first open dissent came when the foreign secretaries of Great Britain, Russia, China, France, and American Secretary of State Byrnes met in London, starting Sept. 11, 1945, to draft peace treaties with Italy, Rumania, Hungary, Bulgaria, and Finland. But after three weeks spent in disputes, the conference adjourned without result.

During this time Russia demanded a share in the occupation and control of defeated Japan. In December an Allied control commission was appointed to consult with General MacArthur on the administration of Japan; but he remained the sole authority. But Russia imposed control on the southern half of Sakhalin Island and on the Kurils, former Japanese possessions. It shared occupation of Korea with the United States, but agreed to withdraw from Manchuria in favor of China in return for Chinese recognition of independence for Outer Mongolia.

Outbreak of Rebellions and Civil War

Meanwhile, revolts broke out in some of the regions released from Japanese domination. In the Netherlands Indies, Indonesian Nationalists set up a republic in August 1945. Dutch troops failed to crush the movement and asked for British aid. The British sent troops, and in the fighting that ensued, each side suffered heavy casualties. In 1946 the Dutch recognized the Republic of Indonesia and in 1949 the United States of Indonesia—a federation of 16 states. In 1950 all the states united to form the Republic of Indonesia (*see* East Indies; Indonesia).

France had similar difficulty reestablishing its authority in French Indo-China against resistance by the Viet Namese nationalists who set up a republic in 1945 (*see* France). Britain was plagued by rebellion in Burma, continued demands for independence from India, and insistent demands from Zionist Jews for entry into Palestine. In Greece, Communist guerrillas revolted against the conservative government which the British installed, and Britain had the burden of maintaining order as though Greece were a conquered nation (*see* Greece).

Another bitter struggle erupted, between the Chinese Republican forces and the Chinese Communists. On Jan. 14, 1946, a truce proposed by President Truman's special envoy to China, Gen. George C. Marshall, halted the civil war briefly, but shortly afterward fighting again broke out in Manchuria.

The Russians turned over control of Manchuria to China in April 1946 as they had agreed to do. But previously they had stripped it of machinery. Moreover, the Red forces did not withdraw from the country until well-armed Manchurian Communist troops were in position to resist Chinese authority.

Russia showed its hand also in the Near East. At the close of the European war, Iran asked American, British, and Russian troops—sent there during the war—to withdraw. The Russians refused and encouraged rebels in northern Iran (Azerbaidzhan) to set up an independent republic. (Russia later announced its withdrawal from Iran on May 9, 1946.)

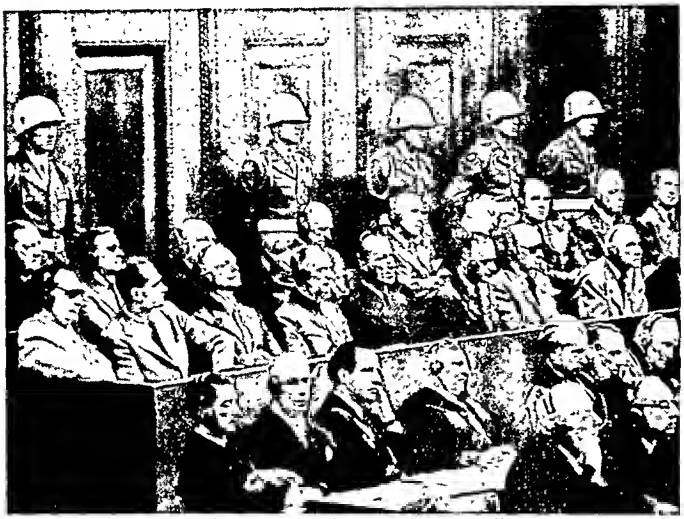
Troubles with Relief and Reconstruction

As the enemy was driven back, UNRRA commenced operations. By 1946 it had helped and repatriated about 6 million people in western Europe and distributed more than 6 million tons of food and supplies.

But ever-mounting dissension plagued the relief program. The United States complained, without avail, that in Poland, Czechoslovakia, and the Balkan States, relief supplies were denied to anti-Communists. American goods were re-marked to indicate Russian origin. In China many tons of supplies fell into the hands of speculators. With the expiration of UNRRA in June 1947, the problem of food relief reverted to the individual nations.

Only one of the reconstruction plans proceeded according to schedule. In March 1945 international

FIRST WAR CRIMES TRIAL



In an effort to prevent future wars of aggression, the Allies prosecuted Axis leaders. Here, high Nazis listen to the verdicts at Nuremberg. In the first row of the box, at left in dark glasses, is Hermann Goering.

representatives (except those of Russia) met in Savannah, Ga., and established the International Monetary Fund and International Bank.

Trials of War Criminals

During the growing dissension, however, the Allies agreed on an unprecedented measure. On Aug. 8, 1945, the United States, Great Britain, Russia, and France wrote a charter for an Allied War Crimes Commission. The commission promptly established a court, defined war crimes, and prepared a list of war criminals. The court convened at Nuremberg, Germany, and called before it 22 leading Nazis, including Goering, Keitel, von Ribbentrop, and Hess.

On Oct. 1, 1946, the court sentenced most of the defendants, and on October 16, ten of them were hanged. Seven were imprisoned, and three were acquitted. Goering committed suicide while awaiting execution. Martin Bormann, who had escaped, was tried *in absentia* and sentenced to hang. Hitler had committed suicide (*see* Hitler).

JAPANESE HEAR SENTENCES

As United States military police stand guard, Japanese accused of being war leaders are sentenced by an international tribunal in 1946. At the extreme left is Japan's wartime premier, Hideki Tojo.

The British hanged Josef Kramer, "beast of Belsen," and Irma Grese, who had been the chief torturer at the Belsen camp. The Norwegian government sentenced its wartime premier, Vidkun Quisling, to death before a firing squad. The British hanged William Joyce (called "Lord Haw-Haw"), whose taunting radio voice they had heard nightly from Germany. The French imprisoned for life their head of state, Marshal Henri Pétain, and shot Premier Pierre Laval, because both men had collaborated with the Nazis.

Immediately after V-J Day, General MacArthur established an Army commission to try more than 2,000 Japanese war criminals. Among the first to be executed (Feb. 23, 1946) was Gen. Tomoyuki Yamashita, "tiger of Malaya." He was held responsible for the torture and killing of Philippine civilians during the Japanese occupation. Lieutenant General Masaharu Homma was shot for permitting the "Bataan death march." This brutal march of 70,000 American and Filipino prisoners cost 17,200 lives. In 1946 an Allied tribunal indicted ex-Premier Hideki Tojo and 27 others for starting a war of aggression and condoning atrocities. The trial ended in 1948. Tojo and six others were hanged December 23; 16 defendants drew prison terms for life.

Controlling Postwar Factors

GRADUALLY, out of all the dissension, the central problems and the basic factors in the critical upheaval began to stand forth more clearly. A striking postwar development was the rapid decline in power of the British Empire.

Decline of British Power

Britain emerged from the war with a battered homeland and a war-weary people. The war had deprived it of income from foreign securities and interests, and it faced an appalling debt. Its navy was no longer an instrument of world power. The airplane and the atomic bomb were the new great weapons, and Britain did not have supremacy with either one.

In an effort to improve their prospects the British elected a Labor government in July 1945 and asked a loan of $3\frac{3}{4}$ billion dollars for 55 years from the United States. Congress approved the loan July 13, 1946. Canada made a 55-year loan for $1\frac{1}{4}$ billion. The Labor regime, however, did not bring economic recovery. Costs of occupation in Germany and Austria and lack of manpower hampered production. A coal shortage in 1946–47 forced industry to shut down for some time.

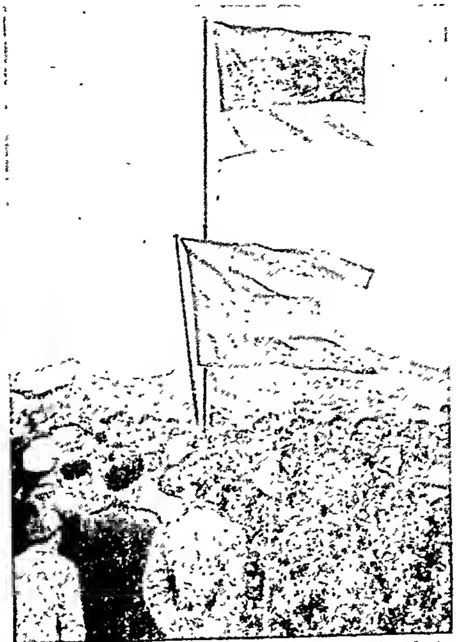
The economic strain and the increase of nationalism abroad forced Britain to start giving up its empire. In 1947 it gave freedom to India, which split into a Hindu state and

a new Moslem nation named Pakistan (*see* India; Pakistan). Britain also in 1947 passed the Palestine issue to the United Nations and entrusted the support of Greece to the United States.

Difficulties in the United States

For more than a year after the war, the United States suffered difficulties which many foreign nations took for signs of weakness. Insistent demand from men in the armed forces and from their relatives led to rapid dismantling of the Army and the Navy. By 1947, the Army was down from its war peak of 8,300,000 to a peacetime strength of 1,070,000. The draft was progressively curtailed, and Congress let it expire March 31, 1947. Navy personnel (officers and men) was decreased from 3,300,000 to 500,000.

HOMELAND AGAIN



In 1952 the Allies returned Helgoland to West Germany. Here the Germans' tricolor is replacing the "E," for Europe, flag.

The country was plagued by shortages, especially in housing, automobiles, and food and clothing. Widespread labor unrest, marked by disastrous nationwide strikes, arose from labor's effort to retain most of its war overtime wage payments for a normal working week. Dissatisfaction with conditions brought a sweeping Republican victory in the 1946 congressional elections (*see* Truman).

Differences with Russia

Meantime Russia acted aggressively to profit from the supposed weakness of the two leading democracies. It built up Communist governments in the nearby "satellite" states (Poland, Czechoslovakia, Hungary, Bulgaria, and Yugoslavia). The Yugoslavian dictatorship of Marshal Tito became increasingly hostile. In August 1946, Yugoslav aviators shot down two American transport planes which strayed over the border. Crewmen of one plane were imprisoned, and those in the other died in the crash. An American protest brought an apology, release of the prisoners, and payment of indemnity.

Communist parties in Britain, France, the United States, and other Western nations redoubled their activities. Many observers suspected a renewal of the old Russian program of spreading Communism by persuasion, revolution, seizure of governments, or any other available means. Others considered the flare-up as protective action springing from suspicion and fear of the United States atomic bomb.

Working out Peace Treaties

A DIPLOMATIC deadlock developed when the foreign ministers of Russia, Great Britain, and France met with United States Secretary of State Byrnes in Paris during April and May 1946 to discuss peace treaties with European Axis nations. For 22 days, Molotov of Russia refused to agree with the others.

Russia was more co-operative when delegates from 21 of the United Nations met in Paris on July 29 to draft treaties with Italy, Hungary, Bulgaria, Rumania, and Finland. The conference set the peace terms, which were submitted to the Foreign Ministers' Council on November 4 in New York City for final approval. The members of the Council were United States Secretary of State Byrnes, British Foreign Secretary Bevin, Russian Foreign Minister Molotov, French Deputy Minister de Murville. They signed the treaties at the French Foreign Ministry in Paris Feb. 10, 1947. The principal provisions of the peace treaties were as follows:

The Treaty with Italy

Territorial: Loss of colonies in Africa (Eritrea, Somaliland, and Libya); final disposition to be decided by the United States, Great Britain, Russia, and France within a year, with possibility of United Nations control. The port of Trieste to be internationalized under United Nations control. The city of Fiume, most of the peninsula of Venezia Giulia, the commune of Zara, and the islands of Lagosta and Pelagosa ceded to Yugoslavia; the Dodecanese Islands to Greece; the Tenda and Briga valleys, other small frontier areas, to France. Italy recognized the independence of Albania and Ethiopia.

Reparations: 360 million dollars: 100 million to Russia, 125 million to Yugoslavia, 105 million to Greece, 25 million to Ethiopia, 5 million to Albania.

Armaments: Combined strength of army, navy, air force, and police, 300,000 men. Allowed 200 tanks, 67,500 tons of warships, 200 fighter planes, and 150 noncombat planes; long-range artillery and aircraft carriers prohibited. Warships in excess of the 67,500-ton limitation to be distributed among the United States, Great Britain, Russia, and France.

The Treaty with Bulgaria

Territorial: Parts of Macedonia and Thrace returned to Yugoslavia and Greece.

Reparations: 45 million dollars to Greece; 25 million to Yugoslavia.

Armaments: Army, navy, and air force limited to 65,500 men. Allowed 7,250 tons of warships, 70 combat planes, 20 noncombat planes.

The Treaty with Hungary

Territorial: 1938 frontiers re-established; restoration, part of Slovakia to Czechoslovakia, Ruthenia to Russia, Transylvania to Rumania—territory taken from Yugoslavia in 1941.

Reparations: 200 million dollars to Russia; 50 million to Yugoslavia; 50 million to Czechoslovakia.

Armaments: Army and air force limited to 70,000 men. Allowed 70 combat planes, 20 noncombat planes.

The Treaty with Rumania

Territorial: Southern Dobruja given to Bulgaria; northern Bucovina and Bessarabia given to Russia.

Reparations: 300 million dollars to Russia.

Armaments: Army, navy, and air force limited to 138,000 men. Allowed 15,000 tons of warships, 100 combat planes, and 50 noncombat planes.

The Treaty with Finland

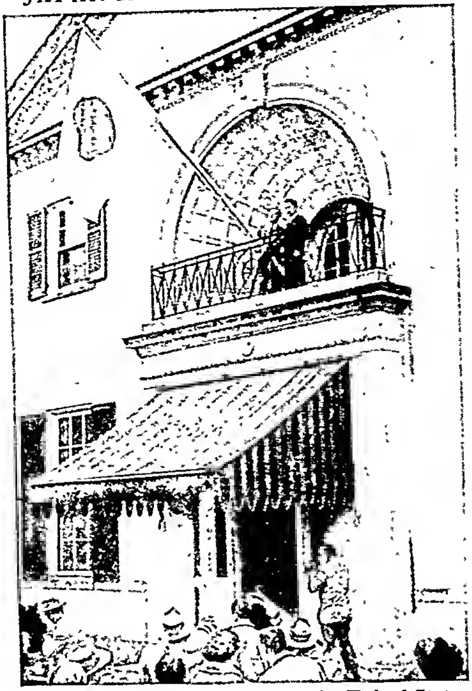
Territorial: Petsamo, Salla, and Karelia regions ceded to Russia; Porkkala Peninsula leased to Russia for 50 years; Aland Islands demilitarized.

Reparations: 300 million dollars to Russia.

Armaments: Army, navy, and air force limited to 41,900 men. Allowed 10,000 tons of warships and 60 planes.

Each of the treaties provided that border fortifications were to be limited to those needed to maintain internal security. Guarantees were given against racial discrimination and the rebirth of fascist governments. The defeated nations were required to grant trade equality to all other countries. The Balkan treaties provided for free navigation of the Danube River.

JAPAN REGAINS SOVEREIGNTY



When the peace treaty between the United States and Japan became effective, April 28, 1952, the embassy in Washington raised its national flag.

The Problem of Germany's Future

All these treaties were much less important than the problem presented by Germany. The victors were determined that Germany should not regain industrial strength which could be used for war. Wiping out all German industry, however, would have been disastrous. Western Europe depended upon Germany for coal and heavy metal products. In return, Germany normally bought huge quantities of foodstuffs from its neighbors. If it could not make and sell manufactures to pay for the food, the victors would have to provide supplies at their own expense.

In addition to this dilemma, the Allied powers had to settle upon a form of German government. The United States and Britain favored a federal type, with most matters entrusted to German states (*Länder*), and a federal government to deal with national matters such as currency. Russia favored a strong central government with political parties directly represented so that Communists could dominate. France favored a federation even looser than the Anglo-American plan, with international control of the Ruhr. (Meanwhile France occupied the Saar in 1945.)

In 1947 representatives of the four powers convened in Moscow to discuss treaties for Germany and Austria. Because of the postwar weakness of Great Britain and France, the conference was chiefly a contest between the United States and Russia.

The conference was soon deadlocked. Russia demanded 10 billion dollars in reparations from Germany in 20 years. The United States rejected this proposal on the grounds that the money could be made available only if the United States supplied an equivalent sum to support the Germans. If the reparations were to be paid without such support, it would greatly hamper Germany's economic recovery. The conference ended with no agreement. Later meetings also failed. Russia then blockaded the roads to Berlin for 11 months and tried other harassing measures in an unsuccessful effort to force the democracies out of Berlin.

In reply, the democracies in 1949 organized their zones in West Germany into a new nation called the Federal Republic of Germany. The Russians then established East Germany as the German Democratic Republic. When Russia continued to block a German peace treaty, the United States in 1952 ratified a "peace contract" with West Germany. (*See also* Germany.)

The Problems of Austria and Trieste

The postwar split between Russia and the West was also illustrated in Austria. After the war, Austria was divided into four areas of occupation—American, British, French, and Russian—with Vienna under the control of all four powers. Despite repeated efforts, all attempts to write a treaty for Austria were stalemated by disagreements on boundaries and on reparations. (*See also* Austria.)

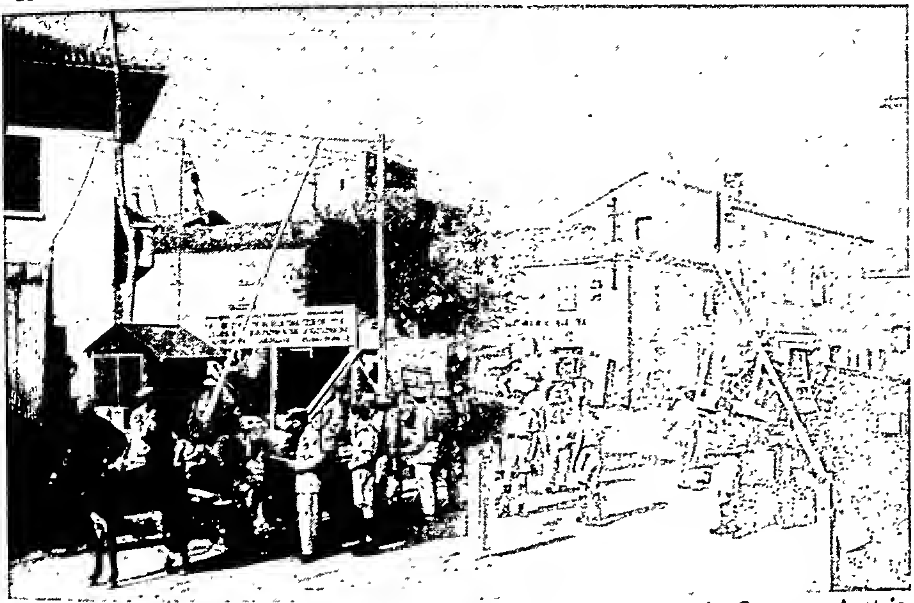
A third postwar trouble spot in Europe was Trieste. In 1945 the city and surrounding territory was divided into two occupation zones, Allied (Great Britain and the United States) and Yugoslavia. The Italian peace treaty of 1947 provided that the "Free Territory of Trieste" would be internationalized under a governor selected by the United Nations. When Russia refused to accept any of the proposed candidates the occupation remained in effect. (*See also* Trieste.)

Meanwhile the increased threat of Communism in Europe led to the formation of new pacts among the free nations. In 1950, ten nations of Western Europe joined with the United States and Canada in establishing the North Atlantic Treaty Organization. Two years later the European Defense Community was founded to build an army composed of troops from six nations. This group received the support of NATO. (*See also* Europe; United States History.)

Postwar Problems in Asia

In the Far East Communist military aggression created a new balance of power before the World

IN EUROPE, ARMED GUARDS AND A "COLD WAR"



When the "cold war" divided Europe into two factions, the peace treaties for Germany, Austria, and Trieste remained unsettled. Here border guards check travelers in Trieste.

War II peace treaty with Japan could be signed. On the Asian mainland Chinese Communist forces routed the armies of Nationalist China, 1946–49. General Mao Tse-tung, the rebel leader, proclaimed the "People's Republic of China" and closely allied the new government with Russia. The Chinese Communist regime thus became the most powerful military force in the Far East. The badly beaten Nationalist troops fled to Formosa. (*See also* China.)

The successful revolution in China set the pattern for organized Communist uprisings in other Pacific countries. In Malaya and the Philippines, armed rebels conducted campaigns of deliberate terrorism. (*See also* Malay Peninsula; Philippine Islands.) In Indo-China, well-armed Communist forces launched repeated attacks against the legitimate government of Viet Nam, which was supported by French troops. (*See also* Indo-China.)

The increasing tensions in the Pacific finally exploded into full-scale warfare when Communist North Korea attacked the Republic of Korea, June 25, 1950 (Asiatic time). United Nations troops (chiefly from the United States and South Korea) aided the Republic of Korea while huge numbers of Chinese Communist "volunteers" fought alongside the North Koreans. With neither side able to gain a decisive victory, the United Nations and the Communists concluded an armistice July 27, 1953. Final settlement of the Korean problem was left in the hands of a political conference. (*See also* Korea.)

The Peace Treaty with Japan

While militant Communism was on the march in the Far East, Japan struggled to rebuild from the crushing defeat suffered in World War II. During this time all Allied attempts to frame a peace treaty were blocked by disagreements between Russia and the United States. Finally in 1951 the United States sponsored a treaty that was signed by Japan and 48 other nations. Russia refused to sign. The Chinese signatory, the Nationalist government, signed the treaty the following year. The chief provisions of the Japanese treaty were as follows:

IN ASIA, COMMUNIST ARMIES ON THE MARCH

The Communist grab for power in Asia began soon after World War II. These tanks of the Chinese "Liberation Army" symbolize the Communist regime that won control of China.

Territorial: Independence of Korea recognized; surrender of all claims to Formosa, the Pescadores and Kuril island groups, the southern part of Sakhalin Island, and the Pacific islands formerly under Japanese mandate.

Reparations: Because of limited economic capacity, Japan was made to pay victimized nations only in services and in goods manufactured in Japan from raw materials supplied by such nations.

Armaments: No limitations; Japan, however, agreed to abide by the anti-aggression provisions contained in the charter of the United Nations.

WORM. In everyday language, almost any small, slender, wriggly animal is a worm. We speak of earthworms, tapeworms, cutworms, wireworms, and acorn worms; yet only the first two deserve their names. Cutworms and wireworms are young insects and acorn worms are related to animals with backbones.

Even "true" worms differ greatly in size, habits, and structure. Many are so small that they can be seen only through microscopes, but others can stretch out to lengths of 80 or 90 feet. Many live in water and some on land; others burrow in mud, sand, or soil; and great numbers are parasites of other animals or plants. Worms also range from simple creatures to many-jointed animals with legs, eyes, jaws, and other organs. These differences mean that worms belong to several great groups, or phyla, which are as different as snails, starfish, and human beings. Four of these phyla are discussed here; a fifth is described in the table on the opposite page.

Flatworms

ON A CLOUDY day, drop some meat into a creek or a clear pool. Dark worms about one inch long soon come to the food. Their flat bodies swim or creep and their pointed heads move from side to side. At the meat, each worm forces a tube called the *pharynx* out of a mouth on its underside. The pharynx pulls off bits of meat and sucks them into a branched *gastrovascular cavity.* This organ serves both as a stomach and as a system of circulation for carrying food to all parts of the body.

These creatures, called planarians, belong to the phylum of flatworms, or *Platyhelminthes.* They are among the simplest many-celled animals, for they have no legs, jaws, joints, or gills for breathing. The gastrovascular cavity has no opening for waste material, which has to pass out of the mouth. However, planarians do possess eyes, nerves, muscles, and several other specialized organs. These are developed from three body layers which show best in the skin, muscles, and lining of the gastrovascular cavity.

Some flatworms inhabit hot regions, where they crawl upon trees or creep on the ground. Others, such as planarians, live in fresh water, where they hide during sunny days but come out to feed at night. Marine flatworms burrow in mud, crawl upon rocks and shells, or hide under seaweeds. Some look like crumpled pieces of brown seaweed two to six inches long; others are gray, green, yellow, or are striped with various colors. They can swim with wavelike movements of their thin bodies.

Two thirds of all flatworms are parasites. Some of these pass through complex life histories. One of the liver flukes, for example, hatches in fresh water and makes its way into the body of a single species of snail. There the worm becomes a baglike young one, or larva. It soon divides into several larvae, and these may divide again and again. At last they produce young worms of another type, with a broad body and a wriggling tail. These larvae swim ashore and crawl upon the grass. There they may be eaten by a cow or a sheep. In its liver the larvae become mature flukes. They produce great numbers of eggs that pass out of the host's body and these begin the cycle again.

Some flukes become mature in the blood or liver of human beings. The Asiatic liver fluke lives in a snail and then in a fish. It gets into human bodies and completes its development when people eat uncooked fish.

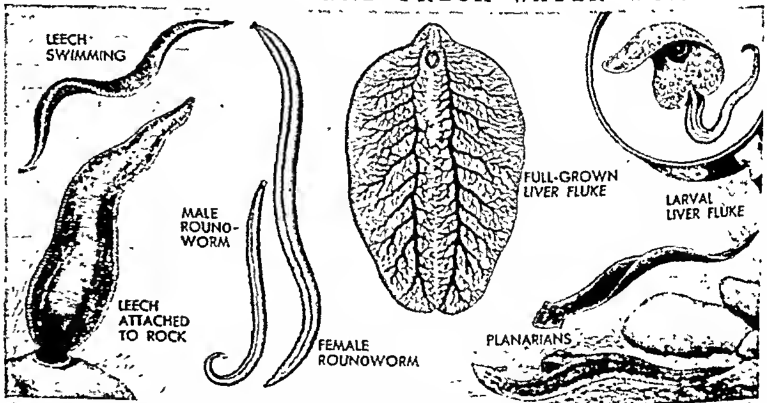
There are more than 1,500 kinds of tapeworms, but only three are common in man. Two begin as larvae that form whitish lumps, called cysts, in the flesh of cattle or pigs. When such "measly" meat is eaten without thorough cooking, the larvae are freed from their cysts and become mature worms. Each has a "head" equipped with suckers and hooks with which it clings to the lining of the intestine. The ribbonlike body consists of thin, flat sections which absorb food and produce great numbers of eggs.

Another tapeworm spends its larval life in a small creature related to the crayfish, and then forms its cyst in the muscles of a true fish. There it stays until the fish is eaten by a cat, fox, bear, or human being. Unless the fish is cooked and the larva killed, it becomes a worm 30 to 35 feet long in the intestine of its human host. This long worm may have 4,000 body sections, each able to produce eggs. Even if countless eggs are destroyed, some always remain to become new tapeworms.

Ribbon Worms

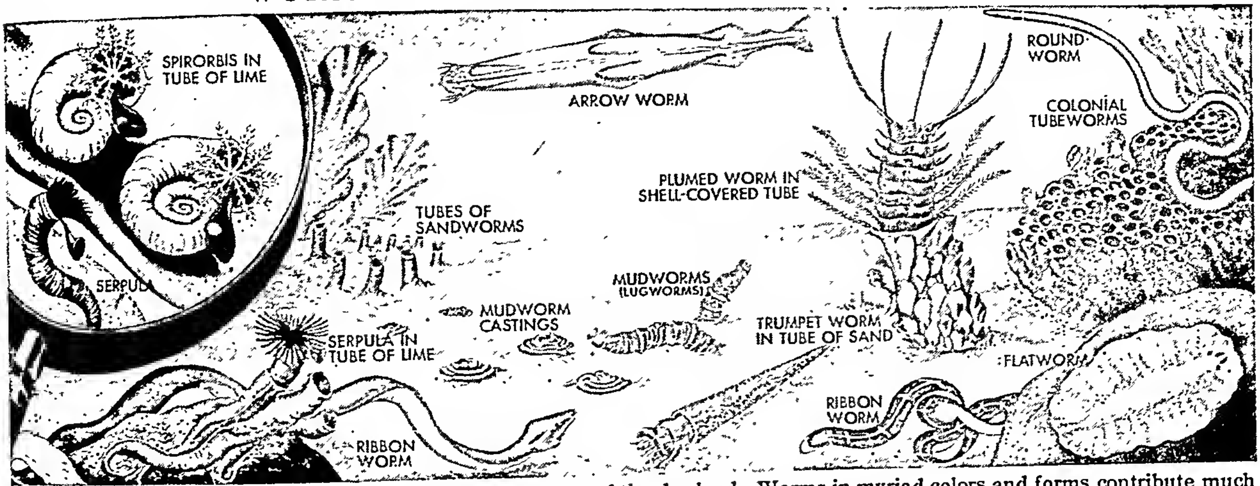
RIBBON WORMS, or *Nemertea,* are soft-bodied creatures that may resemble long planarians, though they have straight intestines with openings for waste. Most ribbon worms live in the sea, where they coil under stones and seaweeds, burrow in mud, or swim in deep, quiet water. When a nemertean finds food it shoots out a long tonguelike *proboscis* which coils around the prey and pulls it into the mouth.

SOME PARASITES AND FRESH-WATER WORMS



Anyone who has swum in a muddy millpond has probably had to peel leeches from his body where they stuck fast to suck blood. The roundworm and liver fluke are harmful parasites of animals; the branched gastrovascular cavity of the fluke shows clearly here. The planarians pictured are harmless fresh-water scavengers.

WORMS THAT LIVE IN SHALLOW SEAS



Living things in the sea are far more varied than are creatures of the dry land. Worms in myriad colors and forms contribute much to the richness and variety of marine life. The fast-swimming arrow worm, nearly transparent in life, is not closely related to other groups of worms. Except for the roundworm, the flatworm, and the ribbon worms, the other creatures shown here are annelid worms. Many of them build tubes of lime or sand for protection. The feathery structures on some of these annelids are gills.

Some ribbon worms are only one fifth of an inch long, but others are 16 feet or more. When one of these creatures stretches out its body and extends its proboscis, its total length is 80 to 90 feet.

Roundworms

ROUNDWORMS, or *Nematoda*, number uncounted thousands of species that live in soil, in fresh and salt water, and in other animals and plants. The worms have round or threadlike bodies with lengthwise bands of muscles. There are no suckers and no proboscis, but some species have sharp toothlike structures, stiff bristles, and thickened rings that run round their bodies. All are covered by a tough protective coat that forms upon the skin.

Many roundworms are parasites. Some species inhabit the roots of plants, causing galls and irregular lumps. Those called gapeworms live in the windpipes of chickens, making it hard for the bird to breathe. Lungworms of several kinds are found in horses, cattle, sheep, pigs, dogs, and cats. The parasites cause coughing, weakness, and other disorders. Lungs may be so badly damaged that the host animals cannot breathe and so die of suffocation.

Two dangerous roundworm parasites of man are the trichina and the hookworm. The former is less than one fifth of an inch long, but it produces thousands of larvae that drift through the blood and burrow into muscles, where they coil and form small, hard cysts. Large numbers of these worms in the body cause trichinosis, a painful disorder that is often fatal. Human beings become infected when they eat pork containing live cysts. The best protection is to cook pork thoroughly. If it looks pink it has not been cooked enough to kill the cysts of trichina.

Hookworms live in hot, moist regions, where their eggs hatch on shady ground. At first the worms feed in soil; then they burrow into the skin of persons who go barefoot. The young worms pass through the body to the intestine, where they fasten themselves with four sharp teeth. They feed upon blood, lymph, and flesh. People seriously infected with hookworms become dull, tired, and anemic, and often contract other diseases. In regions where hookworms are common, people can avoid infection by disposing of human wastes in sanitary fashion and by wearing shoes. Drugs are used to combat hookworm infection.

Many roundworms are able to live in just one kind of plant or animal. One roundworm is found only in the appendix of a human being, and another inhabits only the heads of wheat plants. Other species must go from one particular host to another before they

THE PRINCIPAL GROUPS OF WORMS

"Worm" is a general term for creatures that belong to several different groups, or phyla. Some zoologists recognize nine phyla of worms but others distinguish as many as twelve. The four listed below are the most important and the most easily recognized.

FLATWORMS (*Platyhelminthes*).—The simplest animals that have three body layers. A branched gastrovascular cavity serves both as a stomach and as a circulatory system, but parasitic forms, such as tapeworms, absorb food through the skin. More than 6,000 species live on land, in fresh and salt water, and as parasites.

RIBBON WORMS (*Nemertea*).—Thin worms a fraction of an inch to many feet long. The straight digestive tract is separate from the circulatory system. There are about 500 species, most of which are marine.

ROUNDWORMS (*Nematoda*).—The largest worm phylum. Slender and cylindrical, with straight digestive system, lengthwise muscles, and a tough covering. Many thousands of species live in soil, in fresh and salt water, and as parasites. Trichina and hookworm are most dangerous to man.

ANNELIDS (*Annelida*).—Body round or flattened, in a series of sections, with highly specialized organs, including a nerve cord below the intestines. More than 6,700 species in the soil, on trees, and in fresh and salt water. Earthworms, tube-building worms, and clamworms are familiar members of this group.

A fifth phylum, the *arrow worms* (*Chaetognatha*), contains about 30 species of transparent, torpedo-shaped creatures one to three inches long which are not closely related to other phyla of worms. Arrow worms sometimes are so abundant that several hundred may be found in a single pail of sea water.

mature. Thus one roundworm spends its larval life in a mouse but completes its growth in the cat which eats the infected rodent.

Annelids ANNELIDS, or *Annelida*, include the most familiar worms. Their bodies are divided into ringlike sections and are covered with a tough, moist coat that forms upon the skin. Most annelids have hairlike structures called *setae* (*sē'tē*), which move to and fro. Eyes, jaws, tentacles, and other organs also are developed.

Earthworms and leeches represent two important groups of annelids and are described in separate articles. Another group, the polychete ("many-bristled") worms, are most abundant along seashores, but some inhabit deep water and a few live in streams. Types such as the clamworm capture active prey, crawling and swimming with leglike organs which may also be used for breathing. Other polychetes burrow in mud or sand, where they creep and feed much like earthworms. Many species build tubes on rocks, shells, and seaweeds or in mud and sand.

Some tube-building worms have clusters of gills that look like brightly colored feathers. These are used for breathing oxygen from sea water, but they also produce slimy material called mucus. It captures small plants and animals which the tubeworms eat. If hungry fish bite off the gills—as they sometimes do—the worms quickly grow new ones.

WREN, SIR CHRISTOPHER (1632–1723). With one of the greatest minds of his age, Christopher Wren could have become famous in any one of several fields. It was more by accident than intention that he became England's greatest architect.

He was born in East Knoyle, a country village set among the green fields and hedgerows of Wiltshire in southwestern England. His father, later dean of Windsor and chaplain to Charles I, was then rector of the village church. The small, delicate boy took a great interest in science, particularly mathematics and astronomy, and he was fond of making mechanical "gadgets" of all sorts.

His interest in science continued at Westminster School and Oxford, which he entered at 14. At 25 he was honored with the post of professor of astronomy at Gresham College, London. Soon, he held a similar post at Oxford. A friend of most of the scientific men of his day, he helped to form the Royal Society. One of his scientific achievements was perfecting the barometer as a weather-forecasting instrument.

Wren had always been interested in architecture and he was a superb draftsman. He did not consider himself a professional architect although he accepted Charles II's appointment as assistant surveyor general in 1661. This gave him charge of the repair and upkeep of public buildings. He designed a number of buildings at Oxford and Cambridge at this time. For several years he worked on plans to reconstruct old St. Paul's cathedral in London. Then in 1666 the Great Fire destroyed the cathedral, scores of parish churches, and most of the other buildings of central London. This disastrous event launched Wren on his career as an architect.

He immediately drew up plans for rebuilding the city, providing for broad avenues, wide squares, and long vistas. In city planning he was ahead of his time, and his plans were finally abandoned. London grew up again the tangled maze of narrow streets it had always been. Wren, however, threw himself into the task of designing a new and more magnificent St. Paul's and more than 50 other beautiful London churches. His designs were influenced by the fine baroque buildings erected in France under Louis XIV; but he translated the style into something wholly English in the new St. Paul's and in such lovely churches as St. Clement Danes (for pictures, *see* London). Among his handsomest secular buildings are the "new" wing of Hampton Court near London and the building he designed for the College of William and Mary in America (for picture, *see* Williamsburg).

Wren was twice married and had two children by each wife. He was knighted in 1672 and was a member of Parliament in 1689. He had a singularly sweet disposition and attracted many friends. He took little note of the honors heaped upon him and seldom replied to attacks of jealous rivals. Wren died at 90 and was buried in St. Paul's. No monument was erected at his grave at the time, but over one of the great portals of the cathedral his epitaph was carved. It ends with the words *Si monumentum requiris, circumspice*—"If it is a monument you seek, look about you."

HOW WREN CREATED BEAUTY IN BRICK AND STONE

Sir Christopher Wren built this noble addition to the old Tudor palace of Hampton Court for William III, who enjoyed living there away from the noise and dirt of London. The beautiful and harmonious façades are executed in pink brick and white portland stone. Wren's building overlooks gardens laid out in the manner of King William's native Holland.

WREN. Little "jenny wren" gets its nickname from its fussy housewifely habits. This excitable bird seems to rush from one task to another all day long. The house wren is one of the easiest of birds to attract to the home garden with the offer of a bird box. The female makes the decisions in house hunting.

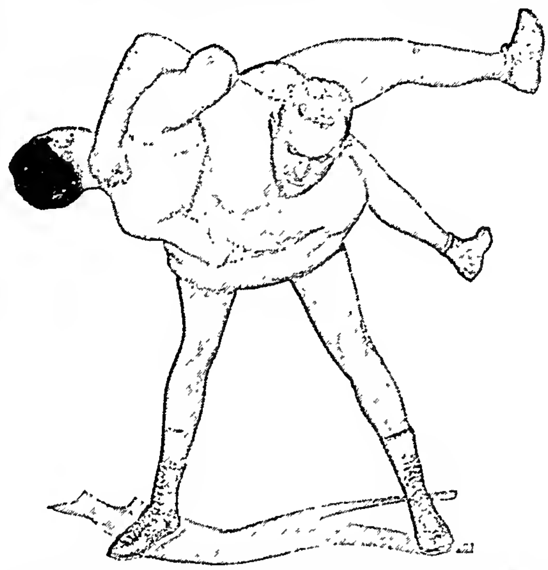
Wrens are brown birds with slender downward curving bills as long as the head, short wings, and nervously twitching, up-tilted tails. Males and females look alike. All are important for their destruction of insect pests. These little birds are among the most beautiful singers, with pure, rippling notes. They raise two broods each season, with 6 to 11 young in a brood. They winter on the southern coast of the United States and in Mexico.

The house wren is about 5 inches long. It nests throughout the United States and Canada. Common in the Southern states are the larger Carolina and Bewick wrens. They nest in brush heaps in the woods. The big cactus wren (8 inches long) and the rock wren are familiar in the arid regions of the Western states. Marsh wrens nest in marshes and wet meadows throughout North America. On the floor of deep northern forests lives the tiny winter wren, 4 inches long. The cactus wren is the state bird of Arizona. The Carolina wren is the state bird of South Carolina. (For picture in color of the house wren's egg, *see* Egg.)

The scientific name of the wren family is *Troglodytidae* ("cave dwellers"); house wren, *Troglodytes aëdon.*

WRESTLING—*The Age-Old Test of* SKILL *and* STRENGTH

WRESTLING. One of the first sports a boy tries is wrestling. Boys of all ages enjoy friendly scuffles with others of their own size. As they grow older many go out for the wrestling team in high school, college, or athletic clubs. In addition to being an exciting sport, wrestling is excellent exercise. It brings into play all the muscles from head to toe.



Here a heavyweight wrestler uses a half nelson and arm drag to slam his opponent to the mat. Amateur rules forbid slams unless the thrower has one knee on the mat.

In wrestling, superior skill often enables a man to defeat a much bigger and heavier opponent. A successful wrestler knows how to use his opponent's own efforts to force a fall with a skillful twist or turn. He learns these wrestling tricks by studying ways of applying leverage to make the best use of his strength.

Wrestling in the United States

The first wrestling matches in the United States were rough-and-tumble bouts in pioneer days. The champion of a community accepted matches from anyone who dared to challenge him. Rules governing these bouts permitted any hold with the arms and legs except strangling. Formal regulations adopted later legalized almost unlimited action, such as tripping and tackling, except tactics which might permanently injure an opponent. This type of wrestling became known as "catch-as-catch-can." It is used by most United States wrestlers, amateur and professional.

Many schools, colleges, and clubs now have wrestling teams under the supervision of a trained coach. Several states hold annual tournaments for high-school wrestlers. College teams meet in dual matches and in an annual tournament under the National Collegiate Athletic Association (NCAA). Collegiate wrestlers compete in classes according to their weight—121 pounds, 128 pounds, 136 pounds, 155 pounds, 165 pounds, 175 pounds, and the unlimited heavyweight division. High schools have classes as light as 85 pounds. A boy weighing 166 pounds or more usually wrestles in the heavyweight division.

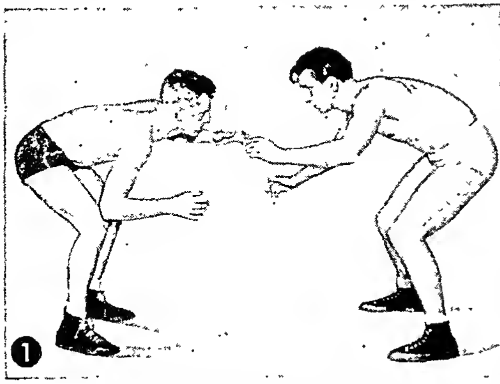
Each year the Amateur Athletic Union holds a tournament to decide the catch-as-catch-can champion in each weight division. It also arranges matches conducted in the Greco-Roman style of wrestling. This style was developed in France and has little in common with the sport of ancient Greece or Rome. The rules are similar to those of catch-as-catch-can except holds below the waist and tripping are illegal. It is much more popular in Europe than in America. Both styles of wrestling are a part of the Olympic Games. The catch-as-catch-can style was introduced in 1904, the Greco-Roman style in 1906.

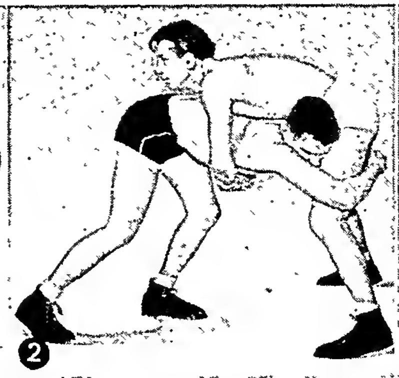
The standard wrestling mat is 24 feet square with two or three inches of padding underneath. Amateur matches usually consist of three 3-minute bouts with no rest period in between. The object of a match is to secure a "fall" by pinning both shoulders of the opponent to the mat at the same time. A fall in the first period wins the match. A fall in the second period automatically ends that period and limits the third period to the same length of time as the second. If no fall occurs in a match, the referee names the winner on the basis of points scored for skill and aggressiveness. Two points is the most that a contestant can win for any hold or position.

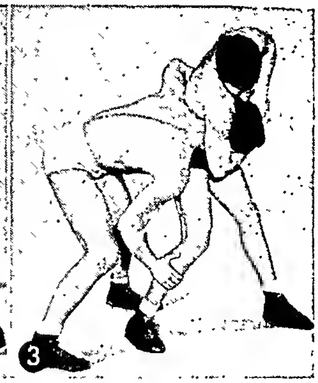
National Variations in Wrestling

In addition to catch-as-catch-can and Greco-Roman, there are almost as many different styles of wrest-

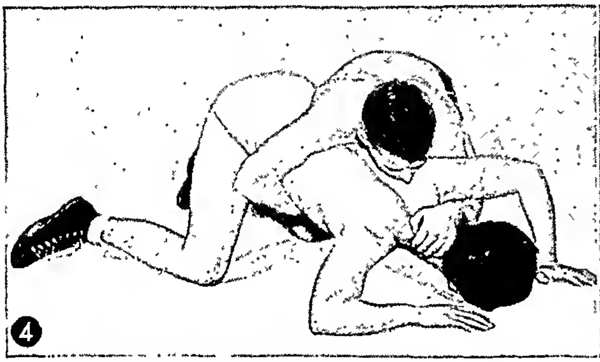
HOLDS THAT EVERY GOOD WRESTLER SHOULD KNOW

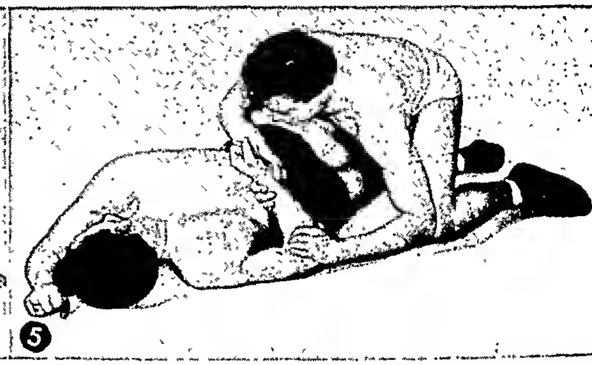




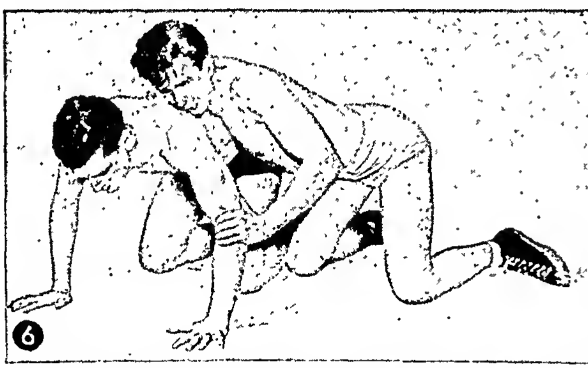


1. Two amateur wrestlers (165-pound class) start a match in the neutral or *on guard* position. (Call them Black and White from the color of their trunks.) Footwork is important here for gaining a favorable position. 2. Black gains an advantage with a double-leg pickup. White avoids an immediate *take-down* with a waist hold. 3. Black changes to a headlock to throw opponent to mat.





4. Black has thrown his rival and now applies a half nelson with his left hand. 5. White has escaped the half nelson and gains the advantage with a hammer lock. Twisting hammer locks and those forced above the small of the back are illegal.



6. In trying to escape the hammer lock Black rolled off the mat. The referee stopped the match and here gives White the advantage in the *referee's position.* 7. Black rallies and now grips White in a head scissors and arm hold.

8. Black continues his advantage with a waist hold and arm drag (with his left hand). White blocks on Black's chin and *bridges* to prevent a fall. 9. Black has broken the bridge and pins White's shoulders to the mat. Referee signals "Fall."

ling as there are peoples. In the national style of Ireland, "collar-and-elbow" wrestling, the rivals wear short jackets with strong collars and grasp each other's collar behind the left ear with the right hand. The position of the hands cannot be changed until a fall is secured. Changing the position of the hand is a foul and loses a fall. Two shoulders and one hip or both hips and one shoulder must touch the floor at the same time for a fall.

In the Cumberland and Westmoreland styles of wrestling, popular in England, the contestants stand chest to chest and grasp each other around the body. The hold must be maintained throughout the bout. The first rival to touch the floor with any part of his body except his feet loses the fall. A Swiss type of wrestling called *schwingen*, or swinging, is also popular in Russia. The rivals take holds on strong belts attached to the wrestling breeches. Lifting and tripping tactics are employed, and the first man down loses the fall.

Wrestling in Japan dates from before the Christian Era. Two styles are popular, *sumo* and *jujitsu*. Sumo is the national style. Weight is the chief factor, and so most Japanese sumo wrestlers are enormously bulky. The methods are similar to those of catch-as-catch-can, but touching the floor with any part of the body except the feet or leaving the mat loses the fall. A similar sport is popular in India, but both shoulders must be pinned to the mat at the same time.

Tricks of Jujitsu

Jujitsu (also jujutsu and judo) was introduced into Japan from China many centuries ago. For ages it was a secret art, guarded jealously by the nobility. Now it is known not only throughout Japan but in many countries of the world. During the second World War all United States combat troops learned judo as a means of fighting without weapons. In peacetime, women as well as men may learn this so-called art of self-defense.

Jujitsu is hand-to-hand fighting based not so much upon sheer strength as upon ability to strike or grasp a foe so as to numb or disable him. Blows are struck with the outside edge of the open hand or with the heel of the palm rather than with the fist.

The expert makes use of such sensitive spots as the "funny bone" (the partly exposed nerve of the elbow), the solar plexus or nerve center above the stomach, the nerves of the upper arm, the Adam's apple, the ankle and wrist bones, and the groin. Carried to extremes the tricks of jujitsu can be fatal.

The art of falling without injury is a first principle of jujitsu. Often an expert will fall purposely in order to trap an unwary opponent into a dangerous position. This is called "conquering by yielding." The experienced contestant can frequently deflect the force of his opponent's attack so completely that the attacker will suffer a strained muscle or broken bone. In jujitsu matches the one in danger of injury from an opponent's grip admits defeat by tapping the floor with hand or foot. Unlike wrestling, a fall is not necessary for victory.

Wrestling was a popular sport in ancient times. Egyptian slabs, dating back perhaps to 3000 B.C., picture wrestling scenes with almost all the "holds" we know today. In the 'Iliad', Homer wrote of a great wrestling match in which Odysseus defeated Ajax for the shield of the slain Achilles. Wrestling was featured in the Olympic games of ancient Greece. The throne of Japan was the prize in a match between two sons of the emperor in 858. Koreshito won and ruled as Emperor Seiwa. Down through the ages wrestling remained a popular sport in many lands.

In the United States the first professional to win national recognition as catch-as-catch-can champion was a heavyweight, Tom Jenkins of Cleveland, Ohio. He ruled as king of his division from the 1890's until 1908, when he lost to Frank Gotch of Iowa. Gotch has often been called the greatest catch-as-catch-can wrestler of all time. After he retired in 1913 professional wrestling began to lose favor with the public. Few outstanding men appeared in any weight division. Many bouts were faked—the winner was selected in advance and the contestants merely put on a show for the fans. The sport became so unwholesome that some states barred matches except as exhibitions.

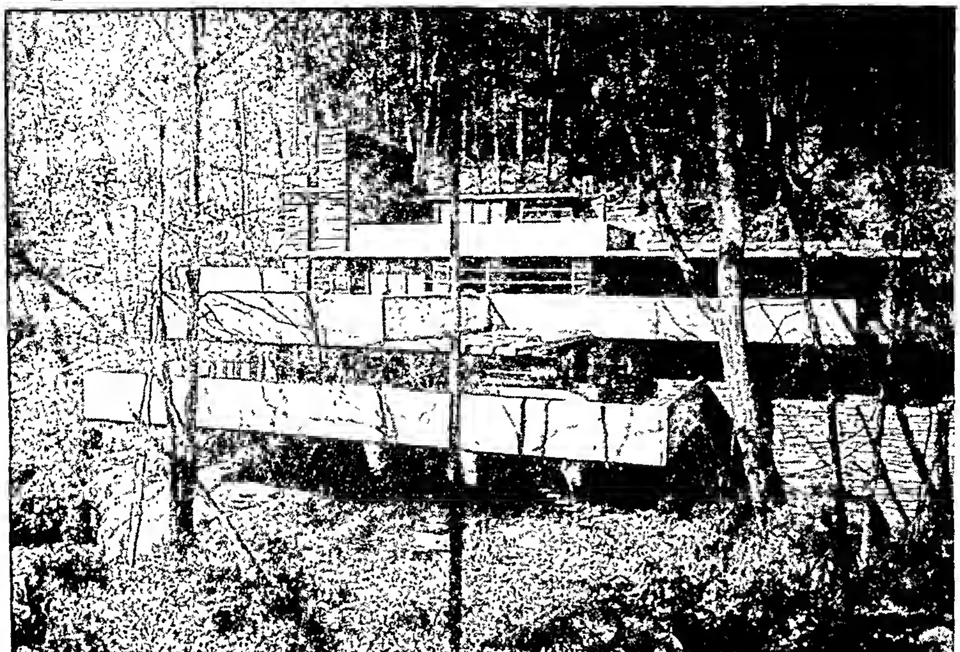
Wrestling has retained its popularity in the United States chiefly because of the amateurs. Amateur wrestling enjoyed an honorable and dignified growth since its organization by the Amateur Athletic Union in 1888. Wrestling teams representing colleges began to arrange matches with one another about 1900. The first formal competition between schools grew out of the Intercollegiate Wrestling Association, formed by eastern colleges in 1903.

WRIGHT, FRANK LLOYD (born 1869). The most famous architect of his time was Frank Lloyd Wright. He was an outstanding pioneer in turning from traditional forms to designs based on the building's main purpose and its location. His expert use of new materials and construction methods made his buildings models of engineering efficiency as well as architectural beauty. But for many years Wright was in advance of his time, and he had to fight for acceptance of each new design.

Wright was born June 8, 1869, at Richland Center, Wis. His father was a preacher and music teacher from New England. His mother, Anna Lloyd (Jones) Wright, was a daughter of a Welshman who had settled in the Wisconsin River valley. She encouraged her curly-haired, blue-eyed son to become interested in creative enterprise. When Wright was 15 he entered the University of Wisconsin. He studied engineering because the school had no course in architecture.

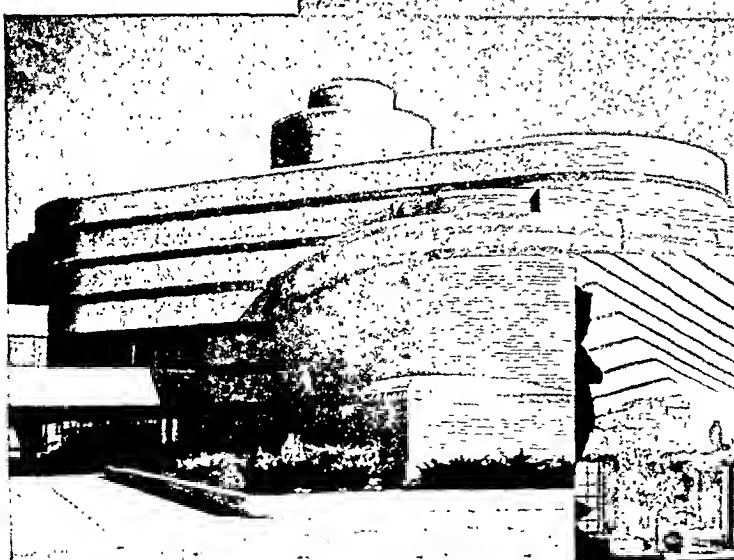
In his fourth year he left college to work as an architectural draftsman in Chicago. The next year he became Louis H. Sullivan's personal draftsman. Sullivan was famed for his development of the skyscraper. He already had abandoned accepted forms and he inspired Wright with his credo: "Form follows function." In later years Wright spoke of him with respect and admiration as "The Master." When Wright was 21 he married Catherine Tobin. They had six children.

THE WORK OF A GREAT AMERICAN ARCHITECT

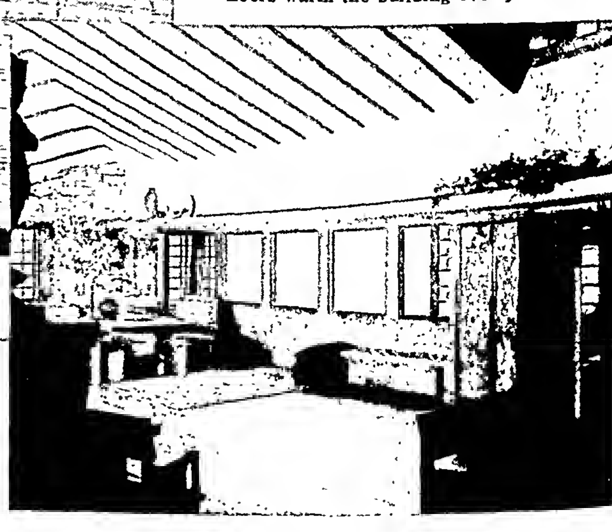


These pictures show examples of the work of Frank Lloyd Wright, world-famous master of functional design. They illustrate his theory that architectural beauty should be created out of the essential engineering elements of a building—its skeleton framework, its supporting beams, its structural materials of wood, stone, brick, or concrete. He cried out against decorative features applied to a building without definite relation to its underlying structure. At the left is Fallingwater, a home at Bear Run, Pa. It seems a very part of its wild, rocky setting. Reinforced concrete, in cantilever construction, was used for this "extension of the cliff beside a mountain stream."

At the right is Willits House, Highland Park, Ill. Built in 1901, it is a good example of Wright's extensive activity in Chicago suburbs. Wright said: "At this time, a house to me was obvious primarily as interior space under fine *shelter*. The planes of the building parallel to the ground were all stressed, to grip the whole to earth."



What use are conventional windows in a modern air-conditioned office building? Wright answered the question by designing this famous structure for S. C. Johnson and Son, Inc., at Racine, Wis. The walls are solid brick with layers of glass between them to admit light. Inside, mushroom-like pillars, narrow at the base, spread out to support the ceiling. Hot-water pipes in the floors warm the building evenly in winter.



To the right is a room of Wright's residence near Spring Green, Wis. Built on a hill overlooking a 200-acre estate, it is named Taliesin (Welsh for "shining brow"). Horizontal lines and spaciousness are keynotes of the exterior as well as the interior. Taliesin was designed both as a home and workshop where Wright and his many disciples could study building materials and experiment with structural methods.

After they were divorced, Wright married twice more. He and his third wife had one child.

Soon after Wright started to work for Sullivan, he was given most of the firm's house designing to do. Wright loved luxury and his expenses mounted. To pay his many debts he designed houses for private clients in his spare time. Sullivan disapproved and Wright set up his own office.

WRIGHT—ARCHITECTURAL GENIUS

Here Frank Lloyd Wright discusses one of his celebrated designs with interested observers.

As an independent architect, Wright created the houses for which he is best known. They have low-pitched roofs, extended lines, and are so suited to their environment that they seem to grow in place. In 1905 he built his first office building for a Buffalo firm. Wright visited Japan and Europe. In 1911 he returned to build Taliesin, his own home, on his grandfather's farm. Taliesin burned soon after completion but Wright rebuilt it. In 1916 he was called to Japan to build the earthquake-proof Imperial Hotel. To withstand shocks, Wright used a cantilever construction and floated the huge hotel on an underlying sea of mud. The hotel suffered but little in Japan's catastrophic earthquake of 1923.

A European exhibit of Wright designs won him Europe's designation as the creator of "the American Expression in Architecture." America itself had credited him with no more than being the originator of "the new School of the Middle West."

In 1928 Taliesin again burned. Wright started to rebuild. When the depression of the 1930's limited new building, he wrote articles and books and lectured widely. In 1932 he established the "Taliesin Fellowship," for paying students. In this school the students learned by actually working with building materials and with problems of design and construction. In winter the school moved to Taliesin West, a beautiful desert camp near Phoenix, Ariz.

Wright's American reputation grew steadily. Among his designs were great buildings, low-cost housing, churches, and plans for decentralized cities. Many of his most ambitious plans remained unbuilt. He received many honors in America and abroad. In 1949 his fame was assured with the award of the gold medal of the American Institute of Architects. The citation in part reads: "Frank Lloyd Wright has moved men's minds . . . he has kindled men's hearts . . . he was and is a titanic force."

WRIGHT BROTHERS: WILBUR (1867–1912) and ORVILLE (1871–1948). The Air Age began on Dec. 17, 1903. On that day the Wright brothers piloted the world's first flights in a motor-driven, heavier-than-air plane. The Wrights succeeded where previous experimenters had failed, for two reasons. One was that the wings of their plane were correctly designed to meet the flow of air. The other was that they could control the plane in turns and banks by a combined use of rudder and wing warping (bending the wing tips). Wing warping, later developed into aileron controls, was their greatest contribution to flight.

The father of the Wright brothers was Milton Wright, a clergyman, later a bishop, of the Church of the United Brethren in Christ. Wilbur was born April 16, 1867, near New Castle, Ind. Orville was born in Dayton, Ohio, Aug. 19, 1871. Wilbur read much, did well in high school, and helped his father write a church paper. A skating accident made him an invalid for several years. Orville was the shorter and more lively of the two. Both grew into thin wiry men. While in high school, Orville built a printing press and started a weekly newspaper. Wilbur joined in this enterprise and thereafter the two were inseparable. Neither brother ever married.

In 1892 they opened a bicycle sales and repair shop. The gliding experiments of Otto Lilienthal, Octave Chanute, and others interested them. After Lilienthal was killed in a glider in 1896, they experimented with planelike kites. In 1900 they built their first glider, a biplane, and glided more than 300 feet at Kitty Hawk, N. C. In 1901 a still larger glider did not fly well. In building the wings for this they had followed the aerodynamic tables compiled by S. P. Langley and Lilienthal. They tested 200 model wings in a small wind tunnel and proved the tables wrong. The Wrights carefully and pains-

PIONEERS OF FLIGHT

Orville (left) and Wilbur Wright built and flew the first successful airplane and so introduced the Air Age.

takingly computed new ones. Their 1902 biplane bested all records for glider flight. In the winter of 1902–3 the Wrights constructed a still larger plane, and for it built a four-cylinder gasoline motor and a propeller. They planned to launch it from a single rail. The biplane was named *Kitty Hawk*.

Although a strong wind blew on December 17, the Wrights determined to try their plane. Orville lay in the pilot's position alongside the motor on the lower wing, and Wilbur steadied the plane at one wing tip. Orville speeded the motor and after a 40-foot run the *Kitty Hawk* was air-borne. In the 12 seconds before it touched its skids to the ground, the plane flew 120 feet (*see* Airplane). Taking turns as pilots, the brothers flew the *Kitty Hawk* three more times that day. Wilbur piloted the fourth and longest flight, 852 feet in 59 seconds. A strong gust of wind then upset and damaged the plane.

During 1904 and 1905 the Wrights built and tested new planes and engines. Their longest flight, a continuous circle of a field near Dayton, Ohio, covered more than 24 miles at a speed of 38 miles an hour. In 1906 the Wrights were granted patents on the plane.

They did not fly again until 1908. During this period they made repeated efforts to sell their invention, first to their own government, and then to England, France, and Germany. None of them was interested. Scarcely anyone believed that the Wrights had flown.

Late in 1907, the War Department asked for bids on a plane. The Wrights submitted one. In 1908 Orville took a plane to Fort Myer, Va., and Wilbur took one to Europe to prove that they had discovered the secret of flight. Thousands came to fields in France and Italy to watch Wilbur fly. Orville's flights at Fort Myer aroused equal enthusiasm. On one of his flights the propeller broke and the plane crashed. His passenger, Lieut. T. E. Selfridge, was killed; Orville was badly hurt but recovered.

The Wrights formed plane-making and licensing firms in several countries. But other manufacturers used the Wright construction, and the Wrights brought suit. The courts upheld their patents.

Wilbur died of typhoid fever May 30, 1912. For years Orville disputed with Smithsonian Institution officials over whether the Wrights or Langley had built the first successful plane (*see* Langley). Angered by the dispute, Orville in 1928 lent the 1903 plane to the Kensington Museum in London. In 1942 Smithsonian officials made public apology. Orville died in Dayton, Jan. 30, 1948. Later that year the *Kitty Hawk* was returned to the United States. It is now in the National Air Museum in Washington, D.C.

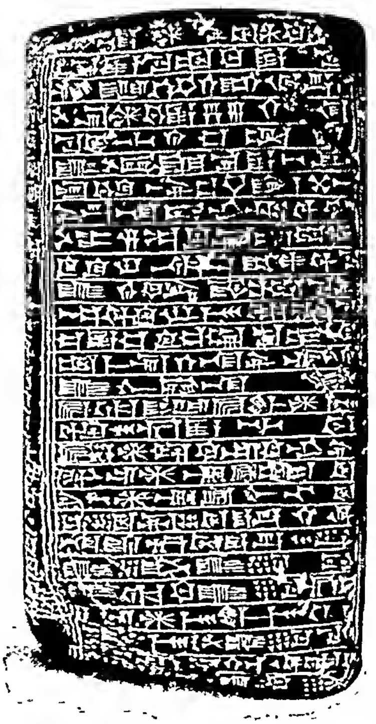
The GREAT INVENTION *Which Preserves* THOUGHTS

WRITING. Perhaps from the earliest times, men have drawn pictures to record important events. Very early they learned also to send a message by drawing a series of pictures, or *pictographs*. Pictography is the oldest form of writing. Some North American Indians used pictographic writing to record their tribal history (*see* Indians).

An important step was taken when these signs were simplified and their meaning expanded. A circle, for example, might stand for "sun," "clear," "day," or "light," depending on the meaning to be conveyed. Such signs are called *ideographs*, or *ideograms*. A further development took place among some early peoples when they assigned specific signs to specific words. A circle then might carry only the meaning "day," for instance. Such word signs are called *logograms*.

Early writing was influenced by many factors, particularly by the materials available. The Egyptians developed beautiful signs called *hieroglyphics* for writing inscriptions on tombs and monuments and for writing religious texts and important documents. (The name hieroglyphic is from the Greek *hieros*, "sacred," and *glyphein*, "to carve.") For less important writing the Egyptians used simpler *hieratic* signs, made rapidly with a brush and ink on papyrus. After the Chinese invented paper, they too wrote their signs with a brush and ink. (*See* Egypt, Ancient; Paper; Papyrus Plant.)

CUNEIFORM WRITING



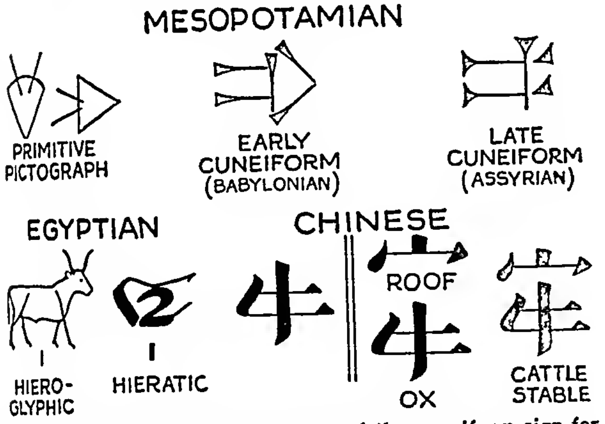
This inscription on black stone tells how Esarhaddon of Assyria restored Babylon in the seventh century B.C.

Because the peoples of southern Mesopotamia lacked both stone and material suitable for making paper, they stamped their signs on wet clay with the cut end of a reed. This method produced wedge-shaped marks; hence we call such writing *cuneiform*, from the Latin *cuneus*, "wedge." To preserve the message, they baked the clay. (*See* Babylonia and Assyria.)

As civilization further developed, men needed more and more signs. Then they devised the simpler method of spelling words according to sound. For example, in English we could write the word *belief* by drawing a bee and a leaf. We call such signs *phonograms*, and a combination of such signs forms a *rebus*.

Each of these phonograms stands for a syllable or group of sounds. The bee stands for *b* and *ee* combined; the leaf stands for *l*, *ee*, and *f*.

DIFFERENT WAYS OF WRITING "OX"



The top row shows the development of the cuneiform sign for "ox." The sign started as a pictograph, a rough sketch of a head and horns. The Babylonian sign, an *ideograph,* imitated the second head by making wedge-shaped characters in clay. Later the Assyrians simplified the sign so that it no longer resembled an animal. The Egyptian hieroglyphic below was an actual picture. It was imitated roughly in the hieratic sign following, which was written with a brush. The Chinese sign is much like the Assyrian, but it is written with a brush and ink and it has a bulge to the left for a head, an upright forehead, and two projections for horns. The group of signs in the corner at the right shows how the Chinese combine "ox" and "roof" to mean "cattle barn."

Every language has hundreds of different syllables, and so this method required hundreds of signs; but still *syllabic* writing was a great improvement over the ideographic, with its thousands of signs. Most early ancient nations adopted the new method, but retained some of the older ideographs. We use ideographs today when we write $ and ¢ for *dollars* and *cents*.

The Chinese resisted this change, and their written language consists largely of ideographs (*see* China). Written Japanese uses many Chinese ideographs but supplements them with syllabic characters (*see* Japan). Most of the American Indians did not advance beyond picture writing, but the Mayas made some use of ideographs. The Aztecs and others who followed the Mayas imitated Mayan writing. Scholars are uncertain how far they advanced, because only a few specimens of their writing survived the Spanish conquest, and even these have not been deciphered completely. (*See* Indians; Aztecs; Mayas.)

The Alphabet and Modern Writing

For a thousand years or more men wrote with ideographs and syllabic characters before they hit on the idea of using an alphabet of single letters. This improvement was not hard to make, because all the syllables in any language are made up of a few single sounds. If signs are adopted for these single sounds, any syllable can be written by combining the right sound signs. For example, to write the English word "belief" we could use the bee phonogram (mentioned above) for the *b* sound, and use the leaf sign for *l*. Then we should need signs for *ee* and *f*. A picture of an eel could do for one, and a fox for the other.

Both the ancient Egyptians and the Babylonians knew how to write in this simple alphabetic way, and they used it occasionally, particularly for writing names. But for the most part they were satisfied with their older ideographic and syllabic writing, and alphabetic writing did not get a real start until some Semitic neighbors of the Egyptians needed to learn how to write, about 1500 B.C. The Egyptians taught them the simple way of writing with "single sound" letters. From this beginning came the Greek and the Latin alphabets which are used today by most peoples outside Asia (*see* Alphabet).

Printed and written letters change constantly; we find many changes in English, even within the past two or three centuries. Washington's handwriting differs markedly from the styles in use today.

As trade and travel bring the nations into closer relations, they tend to adopt the Latin alphabet. The Japanese have begun to use it for commercial purposes, and Turkey in 1928 abandoned the Arabic alphabet for a modified version of the Latin.

HOW THE MAYAS DESCRIBED A FAMILY

The pictographs above mean "Nine Wind and his wife, Ten Eagle, who live at Cloud-Belching Mountain." The mountain, or volcano, is at the left. Then we see Nine Wind, named by a wind symbol and nine circles. His wife is named by an eagle and ten circles. The signs are from one of the few existing manuscripts which show this writing. The people who wrote it lived after the Mayan power had vanished, but they used the Mayan script.

The Fine Art of Writing Good English

WHEN we study English composition, we may have one of two purposes in mind: we may wish simply to write clearly, correctly, and effectively; or we may wish to develop a natural talent and produce the vivid, skilful writing which is an art.

We all need to write correctly, even though we may not hope to become authors, just as we all need to brush our hair, wash our faces, and keep our clothing neat and clean. Slovenly, sloppy, helpless writing is just as much of a social handicap as an unkempt, dowdy appearance. (*See* Grammar; Rhetoric.)

Fortunately, anyone of normal intelligence may, with reasonable study, learn to write correctly. He may be taught, by the aid of a good textbook on rhetoric and a competent teacher, to put his thoughts in writing that is clear, unified, logical, and well proportioned. Devices of sentence structure that will insure variety or clarity are simple to learn. No one need write verbosely, tritely, or ungrammatically.

You Must Have Liveliness

Unfortunately, if we aspire to literary excellence, mere correctness is not enough. To be sure, good

literary writing is damaged by incorrectness and improved by correctness, just as is good commonplace writing. But a tidy little theme, in pretty handwriting on clean paper, with spelling and grammar and punctuation exactly right, may be as dull and boring as a headache. Again, some lively fellow's careless product, with commas missing, grammar trodden under the racing heel of bright vernacular, spelling nearly as strange as Shakespeare's, may breathe that breath of life by which we recognize the presence of the literary gift.

The faulty, lively writing is not good because of its flaws, but in spite of them. It is easier to weed faults out of a student than to infuse vitality into him. Few succeed in any art who do not glow with mental vitality, whose original sensory impressions are weak, whose visual, auditory, and other sensory memories are dim.

Your First Step in Learning to Write

Therefore, if you wish to write professionally, your first study must be the study of yourself. Have you this essential vitality of the spirit? Do your senses emboss impressions upon your memory with distinctness? By vitality we do not mean noisy robustness, aimless coltish activity, violence, exaggeration. Voltaire was a semi-invalid, but he sailed into the stupidities and cruelties of his day like a wild man, ran away, charged back again, with mental energy enough to remake the world's thinking and touch off a revolution. He was splendidly alive to the life about him. Vitality means awareness, responsiveness, keenness.

You may have vitality and intelligence, and still your mind may be one of those which are weak in images. These are by no means necessarily weak minds. They may be capable of rapid and brilliant association of ideas, skilful in logic and reasoning. But they are totally hopeless in the arts.

Developing Power of Imagery

To test yourself for power of imagery, recall to mind some interesting scene—a waterfall, or rapids, for instance. Can you see plainly in your mind's eye the white shine of the water, the green branches of trees beside the stream? Most people can, for most people have visual memory. Can you also recall clearly in your mind the roar of the water, the gurgle between rocks, the whisper of the spray? Then you have auditory memory, which is completely lacking in some people. Can you recall vividly the smell of the mist and rotting leaves, the chill of the water on your hand, the taste of a pine needle or bit of sorrel you may have picked up and chewed, the slip of your foot on a slimy rock and your lurch and sway to recover balance? To do this, you must have memory of the impressions of smell, taste, touch, and muscular movement; such memories are considerably rarer than either the visual or auditory kinds. If such sensory impressions come back to you in imagination almost as clearly as though you were going through the actual experience, you have a foundation for success in writing or in some other art.

Note how Rudyard Kipling, famous for the vividness of his character and nature descriptions, calls in all of the "five senses" but one—the sense of taste—in telling of a landscape in 'Namgay Doola': "The night had closed in rain, and the rolling clouds blotted out the lights of the villages in the valley. . . . The monkeys sung sorrowfully to each other as they hunted for dry roots in the fern-draped trees, and the last puff of the day-wind brought from the unseen villages the scent of damp wood smoke, hot cakes, dripping undergrowth, and rotting pine-cones. . . . The clouds closed and the smell went away, and there remained nothing in all the world except chilling white mists and the boom of the Sutlej River."

If you can not recall sensory impressions to your own mind, you may be absolutely sure that you can never recall them to the mind of a reader. If you can write about lassoing a horse without feeling a pull in the muscles of your arms, you may be sure your reader will feel no such pull. To enable someone else to share his own thoughts and emotions is the task of the artist.

It is of course true that if your memory in some of these aspects is weak, you may strengthen it amazingly by training, by conscious effort to observe more keenly and remember more vividly. Even a person whose mind is by nature a genuine motion-picture theater of vivid images, with sound and smell and touch effects included, may still increase his powers by practise and continued study. But no one can mine gold where there is no ore.

You Must Read and Study

If you believe you have the "ore," begin to mine it by studying good writing, great writing. Absorb its principles into your blood and nerves and ears and eyes—a matter which is a far cry from being able to give an intelligent critical report of what you read. Great writers are usually great readers, but not everyone who has his nose constantly in a book is a great reader. He may be merely a great dunce, a person incapable of extracting the sap of life from the world about him, and wholly dependent on coddling and feeding his mind with the prepared food of books. The intelligent reader reads, not to copy some other man's style, not to prop himself up with some other man's strength, but to see how words and ideas take on new power as they pass through the filter of new minds; how new rhythms and new phrases and new figures appear in the light of another personality. Such observations open out to the reader the infinite possibilities of language, of life, of individual thought; they do not shut him up in the cage of what has been done in the past.

What Makes Good Writing?

After reading attentively and reflectively for a while, you begin to notice certain important facts about good writing. Among them are these:

1. That words have within themselves color, richness, personal life. Some words open like a gate and reveal a long vista. Others are dull, lumpish, unservice-

able. On the outer edge of the exact meaning of a word lies a fringe of suggestion, known as "connotation." "Fist" means simply "a closed hand," but it makes you think of fighting.

2. That sentences and whole passages have rhythm, subtly in tune with the mood, emotion, action, or tone of the subject matter.

3. That one specific instance is worth a score of generalizations; that selectiveness and concreteness are our tools for making clear the complex and the abstract.

4. That simplicity makes for clearness, strength, and beauty.

5. That good writers use very cautiously the passive voice and the verbs "to be," "to appear," "to seem," and "to become," and amateurs are fatally lured by them.

Let us examine these matters one by one, beginning with the flavor of individual words. In no way can they be better studied than by following that ancient piece of literary advice to read the King James version of the Bible. Consider the famous sentence, "Though I speak with the tongues of men and of angels, and have not charity, I am become as sounding brass, or a tinkling cymbal." Why is that a tremendously good sentence? The writer is trying to ring out the idea that a man endowed with rich and kindly feeling will make his natural gifts effective in his life, whereas a man dried up at the source of his emotions will be an echo, a trivial creature. Say it to yourself aloud. "With the tongues of men and of angels." "With the tonnnnnnngues of mennnnn and of annnnnngels." Is not that repetition of the "n" sound significant? Does it not have the depth and richness of a sweet-toned bell? And what could be a more kittle-cattle racket than "tinkling cymbal," with its "*ink ing ym*"? By connotation of the words, by the subtle suggestion of their sounds, as much as by their dictionary definition, the translator conveys the inner thought of the lines which have rung in men's minds for centuries.

Gaining a Feeling for Words

How can one acquire this feeling for words, this gift of tongues? Simply, as has been said, by cultivating and deepening the sensory memories. If you have never listened to the sound of cymbals, *pingity pingity ping*, until the ringing bit into your attention in an almost hypnotic way, until you felt the last nerve-scratch, the very essence of the sound, as a purely sensory experience, and then in brooding moments let it tie itself in your mind with similar essentials of sound and feeling and meaning, you can never truly understand St. Paul's simile, much less make good ones of your own. This ability no teacher can pour into your ear, you must achieve it in the slow, tedious silence of self-discipline.

In much the same way you may gain skill in using rhythm, the second of the matters we are considering. Rhythm is of course easiest to study in poetry.

> Thy long blue solemn hours, serenely flowing.

Thus Browning wrote of an idle day in the Italian hills, fluting along smoothly as lazy hours pass. Of a horseback ride, Browning's rhythm was:

> As I ride, as I ride,
> With a full heart for my guide.

This is exactly the rhythm of a horse when he single-foots.

Rhythm is quite as important, though not so regular, in prose as in poetry. Nowhere can we find better examples of compelling rhythm in prose than in the Psalms. Here is the leaping rhythm of troubled water: "Deep calleth unto deep at the noise of the waterspouts: all thy waves and thy billows are gone over me." How subtly different is the relentless lapping of flood waters: "The floods have lifted up, O Lord, the floods have lifted up their voice; the floods lift up their waves."

Rapid, almost humorous, is the tune of the animated landscape: "The mountains skipped like rams, and the little hills like lambs."

The flutter, frantic dash, and flight of a bird is in: "Our soul is escaped as a bird out of the snare of the fowlers: the snare is broken and we are escaped." Who has not been amazed by the trumpeting march of these simple words? "Lift up your heads, O ye gates; and be ye lift up, ye everlasting doors; and the King of glory shall come in. Who is this King of glory? The Lord strong and mighty, the Lord mighty in battle."

These examples alone should be sufficient to refute that silly piece of advice often given to young writers: "Always make your writing run smoothly." Your writing should run smoothly only when you are writing of smooth running things. When your subject is animated, let your writing "skip like rams."

Avoid the "Dying Fall"

There is one sort of rhythm which will sometimes creep into writing when the writer is quite unaware. It is the rhythm of the "dying fall," in which the sentences fall limp, and droop, and drop, and end with a sickly plop, with the sad sound of a milk bottle rolling down the back stairs. Such a rhythm seriously weakens your writing, unless, like Tennyson in 'The Lotos-Eaters', you wish to convey the mood of drowsy, feeble people. Here are some of Tennyson's lines:

> In the afternoon they came into a land
> In which it seemed always afternoon.
> All round the coast the languid air did swoon,
> Breathing like one that hath a weary dream.
> Full-faced above the valley stood the moon;
> And, like a downward smoke, the slender stream
> Along the cliff to fall and pause and fall did seem.

You may hear this dying fall in your writing if you compose something when you are ill, or tired, or lazy. The only remedy is to "snap out of it." Come to life, and life will come to you.

Use of the Specific Instance

Now we reach the very important matter of the specific instance. Montesquieu, wishing to point out that a despotic government sacrifices the hopes and resources of the future for trifling present gain, says: "When the savages wish to have fruit they cut down

the tree and gather it. That is exactly a despotic government."

G. K. Chesterton, who continually delights us by his surprising use of specific instances, says, in an essay on 'A Defense of Nonsense': "So long as we regard a tree as an obvious thing, naturally and reasonably created for a giraffe to eat, we cannot properly wonder at it. It is when we consider it as a prodigious wave of the living soil sprawling up to the skies for no reason in particular that we take off our hats, to the astonishment of the park-keeper."

He might have been dull, abstract, and unclear by saying: "The feeling of wonder may be aroused by applying the imagination to the contemplation of any common object."

Being specific sometimes takes the form of using similes or metaphors. Oliver Wendell Holmes, in 'The Autocrat of the Breakfast Table', writes: "People that make puns are like wanton boys that put coppers on the railroad tracks. They amuse themselves and other children but their little tricks may upset a freight train of conversation for the sake of a battered witticism."

The abstract, unspecific way of saying it is: "A pun is boring because, while funny in only a silly way, it annoyingly interrupts the flow of conversation."

'The Autocrat of the Breakfast Table' abounds in the admirable use of the specific instance. A generalization is stated, then pointed up immediately by the specific, as in the following bit: "You see, my friends, what immense conclusions, touching our lives, our fortunes, and our sacred honor, may be reached by means of very insignificant premises. This is eminently true of manners and forms of speech; a movement or a phrase often tells you all you want to know about a person . . . . One of my friends had a little marble statuette of Cupid in the parlor of his country-house—bow, arrows, wings, and all complete. A visitor, indigenous to the region, asked the lady of the house 'if that was a statoo of her deceased infant?' What a delicious, though somewhat voluminous biography, social, educational, and esthetic in that brief question!"

The Importance of Being Simple

Just as we must make our ideas clear and incisive by letting the concrete example stand for the abstract thought, and the few selected details tell the tale for the many, so we must reduce our most elaborate, learned, or technical notions to simple language. The beginner scarcely realizes how much harder it is to be simple than to be complicated. The young writer yearns for long words, fancy phrases, obscure verbiage. The mind trained in science, but untrained in expression, feels deeply grieved to read a scientific thought expressed in *human speech* instead of in the jargon of the laboratory.

It is the pride of the makers of Compton's Pictured Encyclopedia to have taken issue with conventional encyclopedia diction and to have put difficult subject matter into words that people can understand. Let us take an example of simple writing—the first paragraph under the heading "Leaves—the Chemical Laboratory" in the Plant Life article in this encyclopedia:

"The most important part of the plant factory is the chemical laboratory—the leaves. The green plant's ability to manufacture food out of nonliving materials is one of the great wonders of science. In the presence of sunlight, the green coloring matter called chlorophyll combines water with carbon dioxide and produces a simple sugar. The process is known as photosynthesis. The word comes from the Greek *photos* (meaning 'light'), and *synthesis* ('putting together'). Photosynthesis means 'putting together with the help of light'. All life on earth depends on photosynthesis. Without it there would be no plants, and without plants there would be no animal life."

That paragraph is so simple that we feel it must have been easy to write. Yet those very same ideas might be expressed in the typical botany or reference work in some such fashion as this:

"Photosynthesis is the fundamental process enabling plants to harness the energy of sunlight and thus build the food that provides the energy for all higher forms of life. In photosynthesis the energy of sunlight acting through the agency of chlorophyll, splits water into two constituent elements, hydrogen and oxygen, and also absorbs carbon dioxide from the atoms. The process has been termed carbon assimilation because of the large amount of carbon dioxide (CO_2) absorbed in its accomplishment."

What is the matter with the second phrasing of the paragraph? Everything. It is heavy-handed and leaden-footed, dull, pretentious, and obscure. It throws a useless smoke screen of scientific jargon about ideas, which although they may be new to the reader, can be made simple. Worst of all, it is not interesting, and it makes a genuinely interesting subject appear to be dull.

Let us note particularly one detail about this rewriting of the paragraph. The words *fundamental*, *enabling*, *agency*, *absorbs*, *constituent*, *assimilation*, and *accomplishment* are all of Latin derivation. Many times you will hear this advice given, "avoid Latin-derived words and stick to the plain Anglo-Saxon."

Words from the Latin Have Their Use

This advice is, in fact, not at all sound, although such writing as Exhibit No. 2 would almost convince you that Latin-derived words are to be avoided. The fact is that Latin words came into the English language centuries ago in the mouths of the Latin-speaking priests and scholars and the French-speaking Normans who conquered England. Hence many of these words have come to be associated with solemn, elegant, abstract, or learned usage. That is *not true* of all of them. The word "table," from Latin, is no more high-flown than "door." On the other hand, when we hear the French speak of putting "undulations" in their hair it makes us grin, because an "undulation" in English is more overpowering in its connotation than is "wave." Latin

words have a roll, a grand sweep, which we should sadly miss from the truly remarkable English language. Shakespeare made excellent use of them in the speech of Macbeth, that "great Neptune's ocean" would not wash the blood off his hand, but that the blood would rather "all the multitudinous seas incarnadine." The moaning roll of those words is much easier to achieve with Latin-derived words than with "plain Anglo-Saxon." We need not, therefore, fear to employ Latin words, but merely refrain from "making our little fishes talk like whales."

Proper Use of Verbs

The same sort of advice applies to the over-use, or misuse, of the verbs "to be," "to appear," and "to seem." One of the conspicuous and universal errors in amateur writing is the heavy output of such sentences as these: "The lake was bright. The waves appeared to be trying to outdistance each other. The scene seemed to be a dream." No genius is required to write, "the lake sparkled, as the waves raced to the shore," and a grain of common sense will lead us to omit the silly bit about the scene.

Mistaken use of the passive voice likewise undermines a sentence. "John was given to understand by Peter that the book was to be found on the shelf," is a poor way of saying "Peter told John the book was on the shelf." The passive voice is bad, when wrongly used, because it is weak. Weakness is bad, always, in your thinking, in your writing, in any art.

Choose Subjects from Your Own Experience

Many more such packages of good advice might be offered the young writer, and still he would feel, "This may all be very true about *how* to write. But *what* shall I write, how shall I go about gathering material, how shall I approach the task of getting it on paper?" The answer is that literature, like charity, begins at home. Write about something close to you, something you know from experience. You may also, of course, find material to write about in books. But there is much more useful training to be had from writing about what is right under your nose. You may have read a fascinating history story about how King Louis built a great fort when he went away on the Crusades. Nevertheless, you were not there, you cannot, without tremendous research, know what the workmen may have said, how they worked, what they thought. But over in the next street, this very day, workmen are putting up a new garage, a commonplace ugly thing, not a bit like a medieval castle. Go over to this garage, listen to the workmen, catch the rhythm of their words and phrases, note the stiffness of that man's new overalls, and the puffiness of this chap with two sweaters under his jacket; watch the movement of their bodies as they hoist two-by-fours, or smear mortar; note the color and texture of fresh bricks or new wood against the blue, or gold, or red, or slaty sky. Then try to put all that on paper so that someone else can really see and hear and smell it too. Never mind whether what you write is a simple description of the scene, or a little story that comes to you as you watch the garage go up, or an account of just how the work is carried forward.

Various Forms of Writing

Writing, as practised by the human race for centuries, has of course developed certain forms, just as clothing has developed styles. We say that a certain piece of writing is a bit of description, an essay, a biography, a poem, a debate, or some form of narration, such as a short story, a novel, a play, or a sketch. It is inadvisable to set your teeth and say "I am now going to write an essay" in a sort of "Pikes-Peak-or-bust" spirit. First, catch your hare, that is, get in mind some material about which you would like to write. Then judge, from the way the material shapes up in your mind, what form would be most effective in developing it. It may lend itself to various forms, and you may gain flexibility and skill as a writer by developing it in several ways.

For example, you may be entertained one day by the sight of a little band of street musicians, or an organ grinder with a monkey. On this theme you may write a simple description, tell how these people looked and acted. You may wish to imagine a day in their life, and give a straight narrative account of it. Such a chronological account is more likely to be a sketch than a short story, novel, or play.

Sketches Are Not Stories

It is not possible here to go into the precise definitions and requirements of short stories, novels, and plays. But in general it may be said that writing a sketch differs from writing a short story in the same way that weaving cloth differs from cutting and making a garment. The sketch never makes a plot, nothing evolves or grows in it. It is really a sort of description which makes use of narrative. Perhaps a genuine story will weave itself in your mind around the figures of the street musicians. Try it out as a short story, or a little play.

Write a poem on the theme, if you catch a poetic glimpse of the street musicians in your mind. Some first-rate poetry has been written by children as young as eight years old. The best of adult poets have usually done their best work while still young. Above all, do not imitate some poem you have heard, but let your poem find its own rhythms. (*See* Poetry.)

Sketches are pleasant to write, and excellent practise before attempting the more difficult forms of narrative. Subjects for them are easy to call to mind. Perhaps your house once caught fire, or you spent a night lost in the woods, or you tried to bake a cake or mend a chair all alone, or you can recall the interesting sights and sounds of a morning on a farm. Any of these may make good sketches. Historical sketches may be written on such topics as the history of your own town, an account of Benjamin Franklin at the French court, or a family Christmas party in 1776. Foreign or ancient Christmas customs are a theme for either a sketch or a simple description, and likewise are accounts of a half-hour in a department store, or ten minutes on a busy street corner. Lively descrip-

tions may be written of a peanut and popcorn stand in a park, a deserted house, an interesting or unusual person you often see, the ways of your pets, or a picture you admire.

If your grandmother has told you a tale of her youth, or you have heard an old legend or half-true story, or have had some exciting experience, you may work out from these themes a more formal and complicated plot, a genuine short story.

The Essay—"A Little Sally of the Mind"

On the other hand, a topic such as "People I Should Like to Have Known" is almost certain to result in an essay. This form of writing may employ bits of narration or description or exposition, but it is best described as "a little sally of the mind" into some subject. The essay need not seek to narrate, to prove, or to solve anything. It merely allows the fancy to play over a subject. Since the writing of a successful essay usually requires sure taste, wide experience, humor, and a strongly developed personality, it is not likely to be done well by a young person. However, if an essay theme suggests itself, do not hesitate because you feel you are too young. Your topic may be well within your powers, and you may have precisely the essay type of mind. (*See also* Essay.)

Like the essay, any piece of exposition requires that its form be developed directly out of the material. It must build its own skeleton as it goes. No story runs through to carry it along. The logical outline and general scheme must be very clear before starting to write. The function of exposition is to explain and to make clear. You may choose a simple subject such as how to make a kite, or explain what you have found to be the best method of studying something, or give an account of glass blowing or any other interesting process of manufacture. Topics requiring research, such as "Changes in the Government of Turkey between the Two World Wars," are valuable if they help you get the habit of knowing the world in which you live and of keeping up with world events. They are detrimental if you merely acquire the habit of talking knowingly of things about which you know little or nothing, or expressing opinions which you have had no opportunity of forming correctly—in short, of "talking through your hat."

Biography a Good Exercise for Beginners

A research subject better suited to young writers than the heavy political subjects so often assigned them is the writing of a biography. The biography should deal with a vivid personality, such as Daniel Boone, Davy Crockett, or Pierre Radisson. You might even try a semifictional biography of that little-known signer of the Declaration of Independence, Button Gwinnett. The movement of their lives will lead you to some sparkle of expression, some imaginative share in the life of their day.

No matter what form of writing you undertake, you must learn by trying various methods to find your own best procedure in writing. Most people find it simplest to jot down in note form their first ideas, sort these out into a systematic arrangement, write an outline in complete sentences, and then develop, fill out, and improve the outline. Others, with a very retentive memory, prefer to plan the whole composition mentally and put on paper a perfected piece of writing. Methods of writing are only to be judged by results. The scheme which gets you the best results, which is best adapted to your own habits of mind, is the best scheme for you.

WYCLIFFE (*wĭk'lĭf*), **JOHN** (1320?–1384). The English priest and reformer John Wycliffe has been called the "morning star of the Reformation" because his teachings had a powerful effect on John Huss and through him on Martin Luther. Wycliffe was a student and later a teacher at Oxford University. In 1374 he became rector of Lutterworth in Leicestershire. By this time he was the chief spokesman in the English church of the antipapal party.

The pope claimed the right to impose taxes and to make appointments to church offices without interference from the king. Wycliffe held that the church should own no property and should concern itself only with spiritual matters. In 1377 he was brought to trial before the archbishop of Canterbury and the bishop of London. A tall figure, pale and thin, with features that bore the marks of self-denial, he faced his accusers boldly. It might have gone hard with him had not a crowd of his London supporters come to his rescue. They caused such a commotion that Wycliffe was allowed to go.

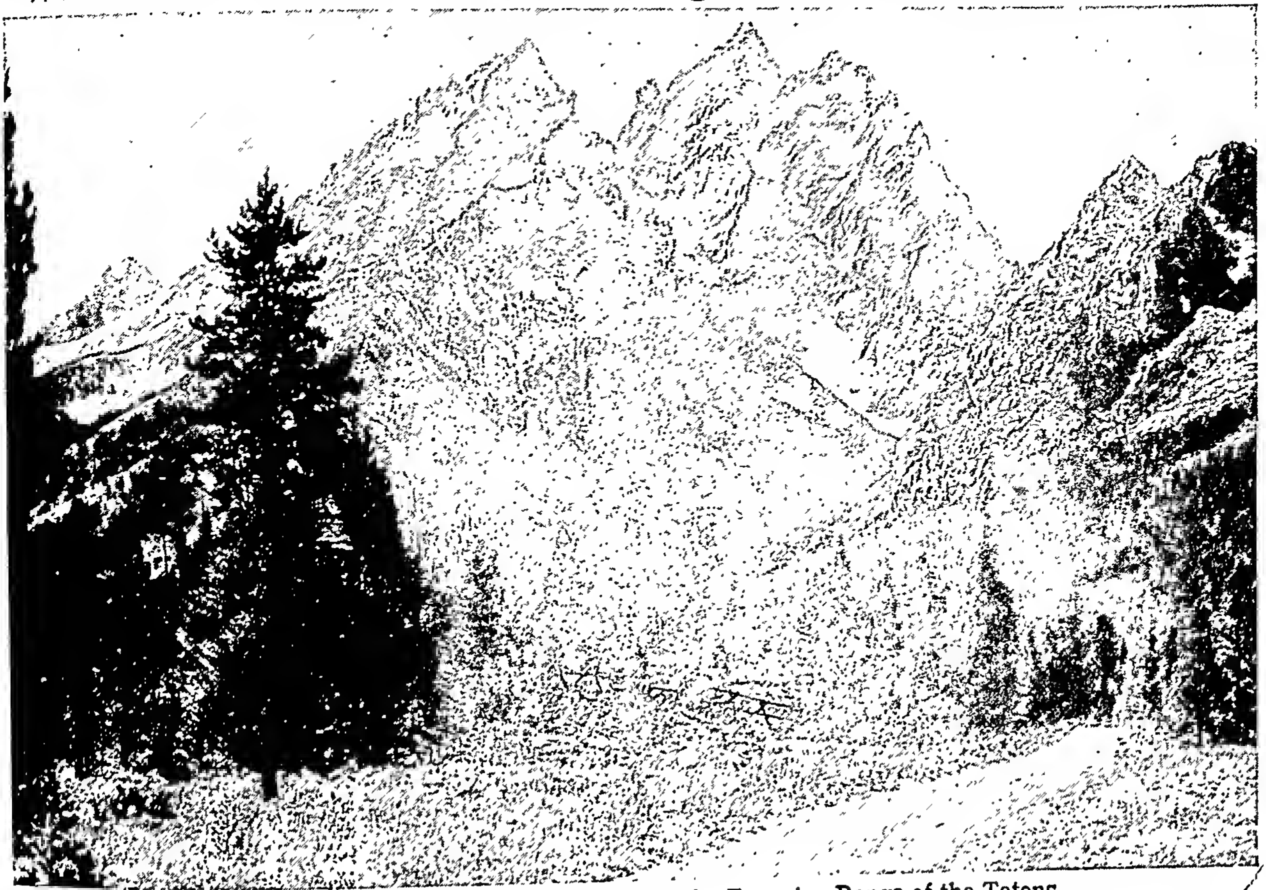
Wycliffe continued to preach as fearlessly as ever, though the pope issued bulls (papal decrees) against him and his teachings were condemned at the University of Oxford. He also wrote numerous Latin treatises to support his attack on the practices and beliefs of the church at that time. As he grew older, he came more and more to believe in the "sufficiency of the Scripture"; that is, the value of the Bible as the only basis of belief. His followers, simple priests called Lollards (from the Dutch *lollen*, a "mumbler" or "mutterer"), traveled throughout the country, preaching faith in the simple gospel of Christ.

In order that people might be able to read and understand the Bible, Wycliffe's followers made the first full translation of it into English (1382). Wycliffe's name was attached to this important work, although his actual share in it is uncertain. The translation had a tremendous influence on religious beliefs. It also set a standard for the language, so much so that Wycliffe has been called the "father of English prose."

Wycliffe had the support of John of Gaunt (the power behind the throne) and of the other great nobles so long as he denounced rich churchmen. He also taught, however, that lordship and property were held only by God's grace and were forfeited if the holders fell into mortal sin. These teachings helped to bring on the Peasants' Revolt in 1381 and lost Wycliffe the support of the nobles.

Wycliffe died in his parish of Lutterworth in 1384 and was buried there. His remains were dug up and burned at the order of the Council of Constance in 1415. (*See also* Reformation, Protestant.)

Where the GREAT PLAINS *Merge with the* MOUNTAINS



A Glimpse of Wyoming's Crowning Glory—the Towering Range of the Tetons

Wyoming. It would require all New England and South Carolina to make another state the size of Wyoming. Its grazing land is larger than Oklahoma and its national forests cover an area as large as New Jersey, Connecticut, and Rhode Island combined. Extensive coal and petroleum fields and other mineral deposits provide the state with a rich underground treasure. Yet Wyoming has a smaller population than that of any other state except Nevada.

Wyoming has an average density of about three persons to the square mile. This is partly due to the state's climate. It is one of the most arid of all the states, with an average precipitation of only about 15 inches a year. Vast areas are suitable only for grazing, with 50 acres needed to feed one animal.

Only two generations have passed since the "Wild West" pioneer days and since the territory became a state in 1890. Therefore Wyoming's full development still lies ahead.

The Nature of the Land

Like only one other state, Colorado, Wyoming is nearly a perfect rectangle. It is bounded by two meridians, about 104° and 111° west longitude, and by two parallels, 41° and 45° north latitude.

The Rocky Mountains cross Wyoming diagonally from northwest to southeast. Covering the widest part of this range, Wyoming ranks second only to Colorado as the state with the highest average elevation in the nation. The crest of the Rockies is called the Continental Divide. To the east, rivers flow east into the Missouri-Mississippi river system. To the west, rivers join the Columbia and Colorado river systems to flow into the Pacific. Between the mountain ranges lie wide valleys and basins. Eastern Wyoming is in the Great Plains region.

Wyoming is famous for some of the most weirdly beautiful landscapes to be seen anywhere. It contains deep and curiously carved canyons, awe-inspiring cataracts, magnificent cascades, and fantastic monuments. It has petrified trunks of trees still standing, and it is rich in fossil remains of gigantic monsters that once roamed its wilds. There are lakes of soda, poisonous and medicinal hot springs and other mineral waters, enormous extinct geysers, chalk mountains, and painted rocks. In the southwest are examples of the famous badland topography found in South Dakota. Most noted of all are the wonders of Yellowstone National Park, in the northwest corner of the state (*see* Yellowstone National Park).

The state's fine scenery has the added attraction of a buoyant, dry climate. The elevation even of the basin lands ranges from a low of about 3,100 feet on the Belle Fourche River in the northeast to between 5,000 and 6,000 feet in the south and gives "mountain lightness" to the air. The sunshine is continuous and brilliant. The dryness also causes Wyo-

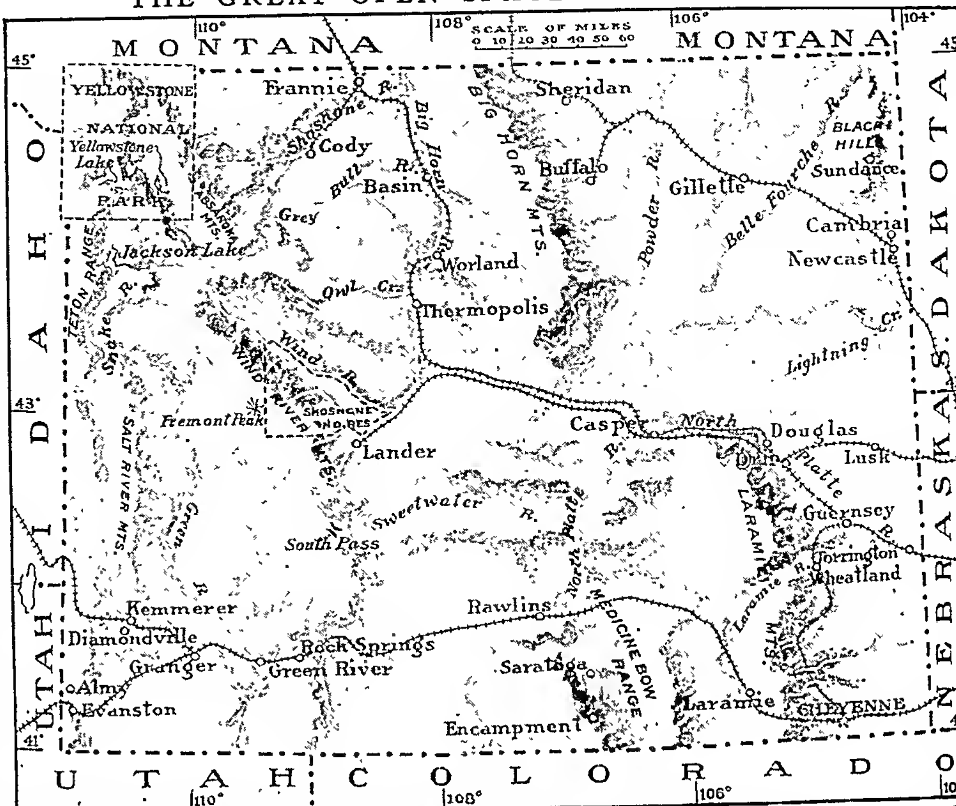
ming's extremes of temperature to be felt less keenly.

Stock Raising and Farming

Years ago, when the only inhabitants of Wyoming were Indians, big herds of buffalo roamed over its grassy plains. The first white settlers brought cattle with them; for a long time livestock raising was the only industry in the state.

Large numbers of sheep were brought in during the 1880's and they proved to be almost as profitable as cattle. Wyoming now ranks among the leading wool-producing states of the nation. Even in the winter months livestock may live in the open and feed on dry, nourishing grass. Most ranchers, however, provide shelter and feed during severe winter weather.

THE GREAT OPEN SPACES OF WYOMING



In western and central Wyoming, broken ranges of the Rocky Mountains rise abruptly from the rolling plains and wide basin lands. The eastern part of the state lies within the Great Plains region.

The settlers also began growing crops in the 1850's; but because of the thin soil and light rainfall crop failures were common for many years. These unfavorable conditions were gradually overcome by two special types of agriculture—farming by irrigation, and dry farming, which conserves as much soil moisture as possible. The growing season within the state varies from 140 days in the southeastern corner to less than 60 days in the extreme northwest.

The chief crop-growing regions lie in the southeastern, the north central, and the western parts of the state. Two thirds of the crop land, or about 1½ million acres, is irrigated. This land produces hay, beans, sugar beets, potatoes, and grain. The remainder, chiefly in the Great Plains region, is cultivated by dry farming. The chief products are wheat, oats, corn, hay, and seed potatoes. Also important are turkey raising, fur farming, and bee raising.

The largest irrigation project is on the North Platte River in the southeast. On the river are Guernsey, Alcova, Kortes, Pathfinder, and Seminoe dams. In the northeast is Keyhole Dam on the Belle Fourche River; in the northwest, Buffalo Bill Dam on the Shoshone; in the southwest, Big Sandy and Eden dams on branches of the Green.

In west central Wyoming is Boysen Dam on the Bighorn River. Also in this section, the Wind River Project stores water behind Bull Lake and Pilot Butte dams. Millions of additional acres could be reclaimed because mountain snows supply ample water to rivers.

Developed and Undeveloped Mineral Riches

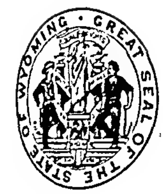
Disappointing yields of gold, silver, and copper obtained by early prospectors led to the belief that Wyoming was poor in mineral resources. Later discoveries revealed rich coal and oil reserves. Coal of bituminous and subbituminous grades underlies at least a third of the area. Petroleum accounts for about three fourths of all mineral production. Teapot Dome, a naval oil reserve, lies north of Casper. Other mineral deposits include natural gas, natural-gas liquids, clays, iron ore, phosphate rock, stone, vermiculite, sodium carbonate and sulfate, gem stones, gold, silver, sulfur, pumice, feldspar, and cement. Sand and gravel exist in many parts of the state.

Industries and Cities

The leading manufacturing industries are petroleum refining, processing food products, and lumbering. Among the most colorful enterprises is dude ranching, including the organization of camping trips into the mountains for hunting and fishing. Such scenic and historical wonders as Yellowstone and Grand Teton national parks, Devils Tower, and Fort Laramie attract about 2 million tourists a year to Wyoming (*see* Yellowstone National Park; National Parks). They spend about 85 million dollars annually to make the tourist trade a major industry.

Continued on page 326

Wyoming Fact Summary



WYOMING (Wyo.): From Indian name for the Pennsylvania Valley where tribe once lived. Means "large plains" or "large meadows."

Nickname: "Equality State," because Wyoming was the first state to allow women to vote. Also, "Sagebrush State."

Seal: Woman on pedestal, holding banner with words "Equal Rights." Two pillars behind her represent the light of knowledge. Two men beside her symbolize the livestock and mining industries of the state.

Motto: None official. Territorial seal carried motto: Cedant Arma Togae (Let Arms Yield to the Gown).

Flag: For description and illustration, *see* Flags.

Flower: Indian paintbrush. **Bird:** Western meadowlark. **Tree:** Cottonwood. **Song** (unofficial): 'Wyoming State Song',—words, Charles E. Winter; music, George E. Knapp.

THE GOVERNMENT

Capital: Cheyenne (since 1869, when it became territorial capital).

Representation in Congress: Senate, 2; House of Representatives, 1. Electoral votes, 3.

State Legislature: Senators, 27; term, 4 years. Representatives, 56; term, 2 years. Convenes the second Tuesday in January in the odd-numbered years. Regular session is limited to 40 days.

Constitution: Adopted 1890. Proposed amendment must be (a) passed by a two-thirds majority of both legislative houses and (b) ratified by a majority of electors voting at next general election.

Governor: Term, 4 years. May succeed himself.

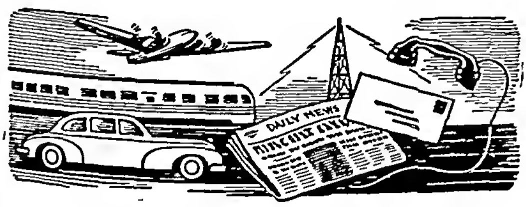
Other Executive Officers: Attorney general, appointed by governor; secretary of state, auditor, treasurer, superintendent of public instruction, all elected; terms, 4 yrs.

Judiciary: Supreme court—3 justices, elected by popular vote; term, 8 years. District courts—7; judges elected; term, 6 years.

County: 23 counties, each governed by a board of 3 commissioners.

Municipal: Mayor and council most common. Sheridan and Cheyenne—commission government since 1913.

Voting Qualifications: Age, 21; residence in state, 1 year; in county, 60 days; in district, 10 days. Literacy test required.



TRANSPORTATION AND COMMUNICATION

Transportation: Railroads, 1,900 miles. First railroad across the state, Union Pacific, 1869. Rural roads, 26,000 miles. Airports, 53.

Communication: Periodicals, 5. Newspapers, 48. First newspaper, *Daily Leader*, Cheyenne, 1867. Radio stations (AM), 15; first station, KDFN, Casper, licensed Jan. 2, 1930. Television stations, none. Telephones, 92,100. Post offices, 260.

THE PEOPLE AND THEIR LAND

Population (1950 census): 290,529 (rank among 48 states—47th); urban, 49.8%; rural, 50.2%. Density: 3.0 persons per square mile (rank—47th state).

Extent: Area, 97,914 square miles, including 408 square miles of water surface (8th state in size).

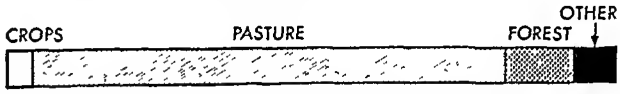
Elevation: Highest, Gannett Peak, 13,785 feet, northeast of Kendall; lowest, Belle Fourche River at state boundary, 3,100 feet.

Temperature (°F.): Average—annual, 42°; winter, 21°; spring, 40°; summer, 63°; fall, 44°. Lowest recorded, −63° (Moran, Feb. 9, 1933); highest recorded, 114° (Basin, July 12, 1900).

Precipitation: Average (inches)—annual, 15; winter, 3; spring, 5; summer, 4; fall, 3. Varies from about 6 in north central to about 30 in northwest.

Natural Features: Rocky Mts. cover much of the state. Continental Divide cuts across state from n.w. corner into Colo.; Bighorn Mts. in north central part; Medicine Bow and Laramie ranges in south central part. Great Plains roll eastward from mountains. Principal rivers: Belle Fourche, Bighorn, Green, North Platte, Powder, Shoshone, Snake. Chief waterfalls: Upper Yellowstone, Lower Yellowstone.

Land Use: Cropland, 4%; nonforested pasture, 78%; forest, 11%; other (roads, parks, game refuges, wasteland, cities, etc.), 7%.



Natural Resources: *Agricultural*—soil suitable to dry farming or irrigation. *Industrial*—minerals. *Commercial*—tourist vacation land (Yellowstone and Teton Parks); dude ranches.

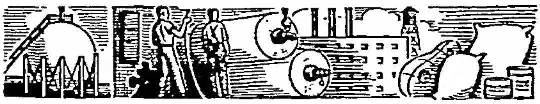
OCCUPATIONS AND PRODUCTS

What the People Do to Earn a Living

Major Industries and Occupations, 1950

Fields of Employment	Number Employed	Percentage of Total Employed
Agriculture, forestry, and fishery	22,278	20.6
Wholesale and retail trade	18,307	16.9
Transportation, communication, and other public utilities	13,918	12.9
Professional services (medical, legal, educational, etc.)	9,237	8.6
Construction	9,116	8.5
Mining	8,726	8.1
Manufacturing	6,490	6.0
Personal services (hotel, domestic, laundering, etc.)	5,816	5.4
Government	5,571	5.2
Business and repair services	3,147	2.9
Finance, insurance, and real estate	2,325	2.2
Amusement, recreation, and related services	1,025	1.0
Workers not accounted for	1,880	1.7
Total employed	107,836	100.0

Wyoming Fact Summary



What the People Produce

A. Manufactured Goods (Rank among states—46th)
Value added by manufacture* (1952), $38,094,000

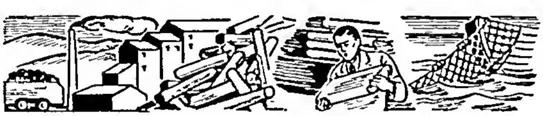
Leading Industries in 1947 (with Principal Products)	Value Added by Manufacture	Rank among States
PETROLEUM AND COAL PRODUCTS... Petroleum refining	$18,363,000	17
FOOD AND KINDRED PRODUCTS..... Dairy products; beverages; bakery products	7,834,000	47
LUMBER AND PRODUCTS........... Sawmills and planing mills	3,566,000	41
PRINTING AND PUBLISHING........ Newspapers	2,209,000	48
STONE, CLAY, AND GLASS PRODUCTS (Such as brick and hollow tile; cement; concrete products, etc.)	1,489,000	45

*For explanation of value added by manufacture, *see* Census.

B. Farm Products (Rank among states—42d)
Total cash income (1952), $159,386,000

Products	Amount Produced (10-Year Average)	Rank within State*	Rank among States†
Cattle..........	263,128,000 lbs.	1	24
Hay...........	1,262,000 tons	2	28
Sheep and lambs.	114,609,000 lbs.	3	4
Wool..........	26,624,000 lbs.	4	2
Milk...........	137,000,000 qts.	5	43
Wheat.........	4,976,000 bu.	6	26
Beans..........	1,030,000 bags	7	6
Sugar beets.....	416,000 tons	8	8

*Rank in dollar value †Rank in units produced



C. Minerals (Fuels, Metals, and Stone)
Annual value (1951), $201,834,000
Rank among states—16th

Minerals (1951)	Amount Produced	Value
Petroleum..........	68,929,000 bbls.	$148,200,000
Coal...............	6,430,000 tons	26,938,000
Clay...............	483,000 tons	5,995,000
Natural gas........	71,508,000,000 cu. ft.	5,363,000
Natural-gas liquids.	1,960,000 bbls.	5,145,000
Stone..............	1,646,000 tons	1,857,000

D. Trade

Trade (1948)	Sales	Rank among States
Wholesale.........	$153,477,000	47
Retail............	309,199,000	47
Service...........	27,790,000	47

EDUCATION

Public Schools: Elementary, 564; secondary, 88. Compulsory school age, 7 through 16. State Board of Education composed of state supt. of public instruction and 6 members from different sections of state appointed by him with approval of governor. Supt. of public instruction popularly elected for a 4-year term; other members serve 6 years. County supts. elected for 4-year terms. City boards of education popularly elected. City supts. in larger cities appointed by city boards; in other cities, appointed by district boards.

Private and Parochial Schools: 18.

Colleges and Universities: University of Wyoming, Laramie, with Northwest Center at Powell, Northeast Agricultural Junior College at Sheridan, and Southeast Center at Torrington; Casper Junior College, Casper.

Special State Institutions: Children's Home, Casper; Training School, Lander.

Libraries: County library systems, 23. State library responsible for aid in developing library service. Noted special library: Wyoming State Library, Cheyenne.

Outstanding Museums: Wyoming State Historical Museum, Cheyenne; Buffalo Bill Museum, Cody.

CORRECTIONAL AND PENAL INSTITUTIONS

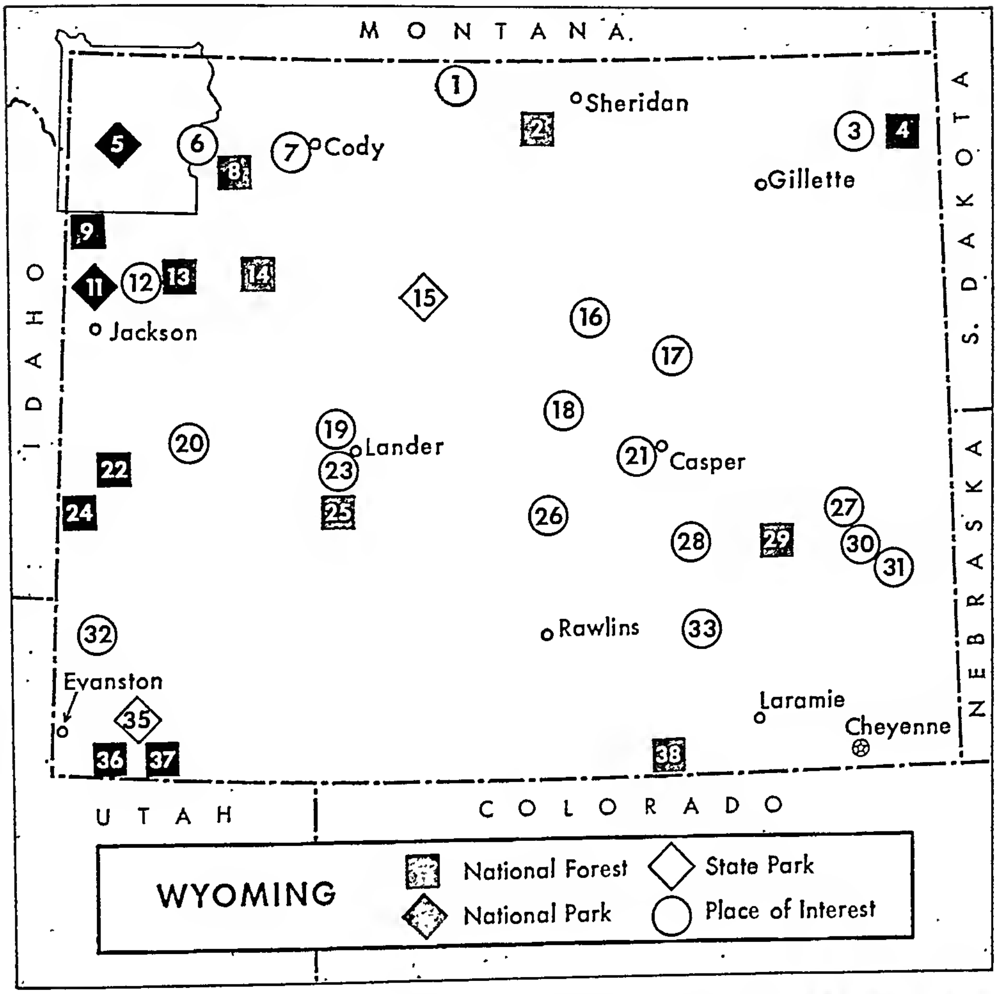
Wyoming Girls' School, Sheridan; Wyoming Industrial Institute, Worland; State Penitentiary, Rawlins.

PLACES OF INTEREST*

Cheyenne—State Capitol; Fort Francis E. Warren, large military post (*see* Cheyenne); southwest of (31).
Church of the Transfiguration—near Jackson; impressive view of Tetons through window behind altar (12).
Devil's Gate—near Three Forks; strange chasm, not formed by erosion (26).
Devils Tower National Monument—first national monument; gigantic lava formation in Black Hills region (3).
Dinosaur Graveyard—fossils near Medicine Bow (33).
Fort Laramie National Monument—near Wheatland; first permanent white settlement in West (31).
Fossil Fish Beds—near Kemmerer; skeletons of strange prehistoric marine animals found here (32).
Glory Hole—near Sunrise; one of the largest open-pit iron mines in the United States (30).
Goose Egg Ranch—near Casper; made famous by Owen Wister's novel, 'The Virginian' (21).
Hell's Half Acre—eerie chasm; near Casper (18).
Hole-in-the-Wall—outlaw hideout near Midwest (16).
Indian Medicine Wheel—near Lovell; huge slabs arranged in circle by sun-worshiping prehistoric tribes (1).
Pahaska Teepee—Buffalo Bill's lodge; near Cody (6).
Petrified Forest—near Casper; trees turned to stone (28).
Register Cliff—near Guernsey; chalk cliff on which thousands of pioneers carved their names (30).
Sacagawea's Burial Place—near Lander (19).
Shoshone Cavern National Monument—mammoth limestone caves near Cody, as yet not fully explored (7).
Sinks—near Lander; river disappears into mountainside, emerges one-half mile lower as waterfall (23).
Spanish Diggings—quarries near Lusk contain stone implements used by prehistoric Indian tribes (27).
Teapot Rock—fantastic rock shape near Midwest (17).
Whitman Monument—near Daniel; in memory of first white women crossing Continental Divide (20).

*Numbers in parentheses are keyed to map.

Wyoming Fact Summary



STATE PARK AND STATE MONUMENT*

Fort Bridger State Monument—in southwestern corner of state; fort established in 1843 by Jim Bridger, a guide; many original buildings; museum (35).

Hot Springs State Park—at Thermopolis; world's largest mineral hot springs; 18,600,000 gallons flow every 24 hours; elk and buffalo (15).

NATIONAL FORESTS*

Ashley—29,950 acres in state; total, 1,115,537 acres in Utah and Wyo.; hdqrs., Vernal, Utah (37).

Bighorn—1,121,541 acres; hdqrs., Sheridan (2).

Black Hills—199,466 acres in state; total, 1,524,997 acres in Wyo. and S. D.; hdqrs., Custer, S. D. (4).

Bridger—1,710,220 acres; hdqrs., Kemmerer (22).

Caribou—7,273 acres in state; total, 1,078,086 acres in Idaho, Utah, and Wyo.; hdqrs., Pocatello, Idaho (24).

Medicine Bow—1,398,288 acres; hdqrs., Laramie (29, 38).

Shoshone—2,458,644 acres; hdqrs., Cody (8, 14, 25).

Targhee—344,573 acres in state; total, 1,691,054 acres in Idaho and Wyo.; hdqrs., St. Anthony, Idaho (9).

Teton—1,729,306 acres; hdqrs., Jackson (13).

Wasatch—16,873 acres in state; total, 1,019,256 acres in Utah and Wyo.; hdqrs., Salt Lake City, Utah (36).

LARGEST CITIES (1950 census)

Cheyenne (31,935): state capital; distributing center for large cattle and sheep-ranching area; railroad shops; military post.

Casper (23,673): shipping point of large wool-producing area; livestock market; oil refineries; sodium works.

Laramie (15,581): railroad stockyards and shops; in timber section; produces cement.

Sheridan (11,500): in coal-mining area; livestock industry.

NATIONAL PARKS*

Grand Teton—299,580 acres south of Yellowstone Park; many peaks in Teton range exceed 10,000 ft.; among most impressive in America; highest, Grand Teton, 13,766 ft.; mountain climbing, fishing, boating; winter feeding ground for American elk herd (11).

Yellowstone—2,039,217 acres in northwest Wyoming; total of 2,213,207 acres in Montana, Idaho, and Wyoming; oldest and largest national park; spectacular geysers; waterfalls; hot springs; Yellowstone Canyon; wildlife sanctuary. (5).

*Numbers in parentheses are keyed to map.

THE PEOPLE BUILD THEIR STATE

1743—François and Louis la Vérendrye and their companions are among first white men to sight Bighorn Mountains of Wyoming.

1803—Louisiana Purchase by U. S. includes most of Wyoming area.

1805—Gen. James Wilkinson named regional governor.

1807—Edward Rose, member of party of trappers, is first permanent American resident in Bighorn Basin. John Colter discovers Yellowstone region.

1811—Wilson Hunt's fur expedition, sent out by John Jacob Astor, crosses Wyoming.

1812—Robert Stuart leads party over route known later as Oregon Trail.

1822—Gen. William Ashley establishes trading post at mouth of Yellowstone River. Jim Bridger, famed frontier guide, arrives with Ashley.

1824—Thomas Fitzpatrick, working for Ashley's fur company, holds first rendezvous (annual until 1840's) of trappers on Henry's Fork of Green River.

1830—Kit Carson, noted scout, arrives in Wyoming.

1832—Capt. B. L. E. Bonneville builds post near mouth of Horse Creek; discovers oil, 1833.

1834—Robert Campbell and William Sublette build first permanent trading post in Wyoming, Fort William (later Fort Laramie), on Laramie River.

1836—Mrs. H. H. Spalding and Mrs. Marcus Whitman accompany missionary husbands across Wyoming; first women to cross Continental Divide.

Wyoming Fact Summary

1843—John C. Frémont leads first expedition to establish military posts for territorial expansion. Jim Bridger builds Fort Bridger on Oregon Trail.

1845—Gen. Stephen Kearny leads expedition to Fort Laramie.

1846—U. S.-British treaty establishes U. S. claim to "Oregon"; includes northwestern Wyoming.

1847—Brigham Young leads first group of Mormons across Wyoming en route to Utah.

1848—Mexico cedes claim to southwestern Wyoming to U. S. Oregon Territory organized; includes Wyoming area; region west of Continental Divide becomes part of Utah Territory, 1850; part of Idaho Territory, 1863; region east of divide becomes part of Nebraska Territory, 1854; part of Dakota Territory, 1861.

1851—First stage line runs through Wyoming from St. Louis to Salt Lake City.

1852—William Vaux opens first school at Fort Laramie.

1860—Central, Overland, California, and Pikes Peak Express Company established. Pony Express riders cross Wyoming until 1861.

1861—Telegraph links Wyoming with East.

1864—Indians attack white settlers along Platte River; Bozeman Trail leading to Montana mines opened.

1866—Forts Reno and Kearney built along Bozeman Trail.

1867—Town of Cheyenne founded. Carissa gold lode discovered; gold rush follows.

1868—Territory of Wyoming created, July 25; Cheyenne designated first capital, 1869; first governor, J. A. Campbell. Peace treaties signed with Indians at Fort Laramie and Fort Bridger.

1869—Public-school system established. Transcontinental railroad links Wyoming with east and west coasts. First women's equal suffrage act in U. S. approved by state, December 10 (day designated Wyoming Day, 1935). Mrs. Esther Morris of South Pass City is world's first woman justice of the peace.

1870—Women serve on juries in Laramie; first women to do so in United States.

1872—First U. S. national park, Yellowstone, created.

1874—Carey Act increases irrigation in Wyoming.

1876—Col. George A. Custer leads troops in Wyoming against Sioux; all are massacred in Montana.

1887—U. of Wyoming opens at Laramie, September 6.

1889—First oil well drilled in Shannon Field.

1890—Wyoming enters Union as 44th state, July 10; capital, Cheyenne; first governor, Francis E. Warren. Present state constitution adopted.

1902—Yellowstone Forest Reserve created as first national forest. (Area originally set aside, 1891.)

1910—Buffalo Bill Dam on Shoshone River completed.

1913—Pathfinder Dam on North Platte River completed; Guernsey Dam, 1927; Alcova Dam, 1938; Seminoe Dam, 1939; Kortes Dam, 1950.

1924—Nellie Tayloe Ross elected governor, first woman governor in U. S. history.

1927—U. S. Supreme Court awards oil lands north of Casper to U. S. Navy in Teapot Dome case.

1929—Grand Teton National Park established.

1948—Uranium deposits discovered near Wamsutter.

1950—Most of Jackson Hole National Monument added to Grand Teton National Park.

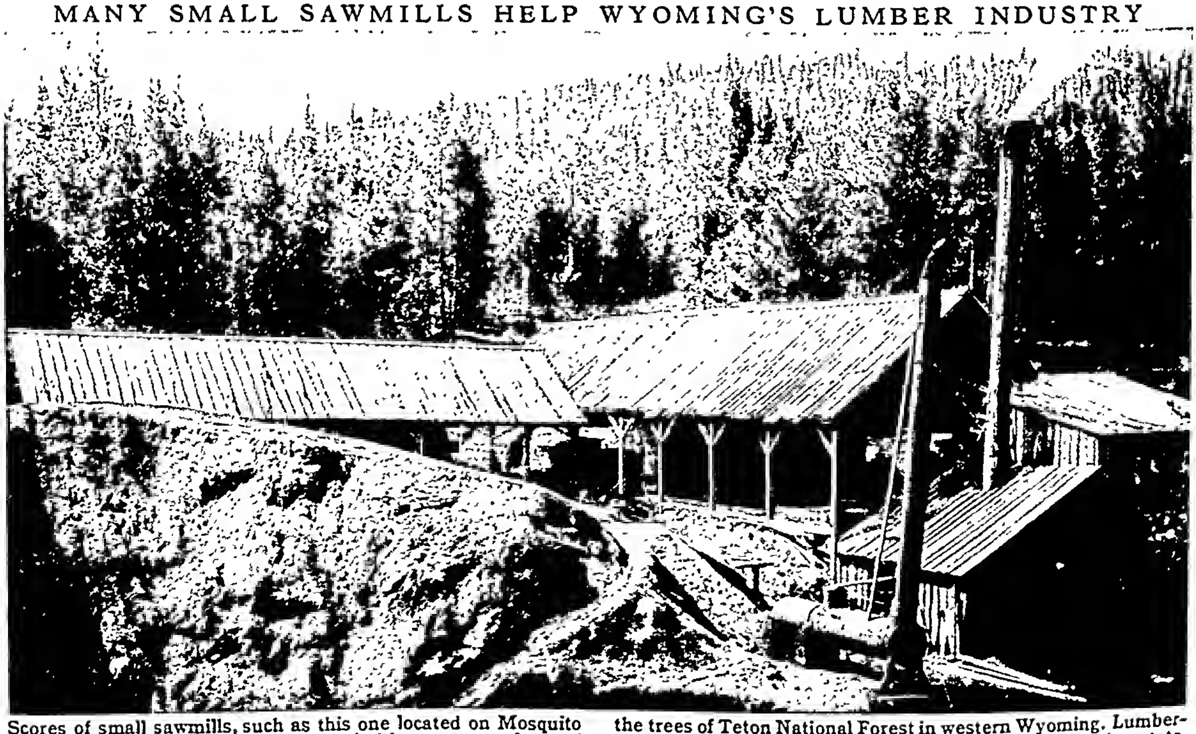
1951—Legislature regulates rainmaking operations.

1952—Boysen Dam on Bighorn River completed.

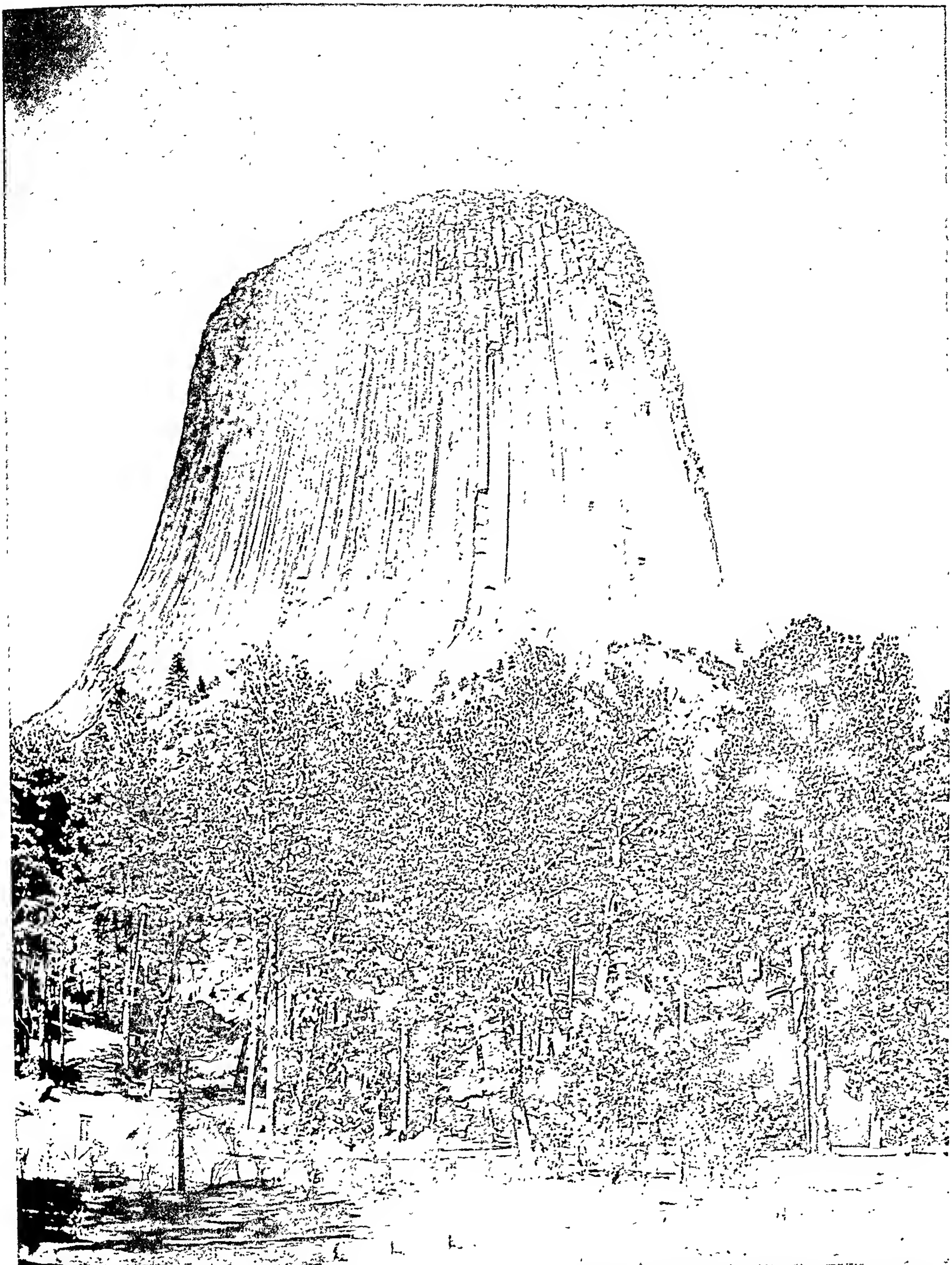
1953—Uranium discovered east of Lander. Casper-Wood River, Ill., oil pipeline, 1,056 miles long, dedicated. Large trona (sodium-carbonate mixture) mine and soda-ash plant near Green River begin operations. Federal aid given in drought.

1954—Titanium deposits found near Iron Mountain.

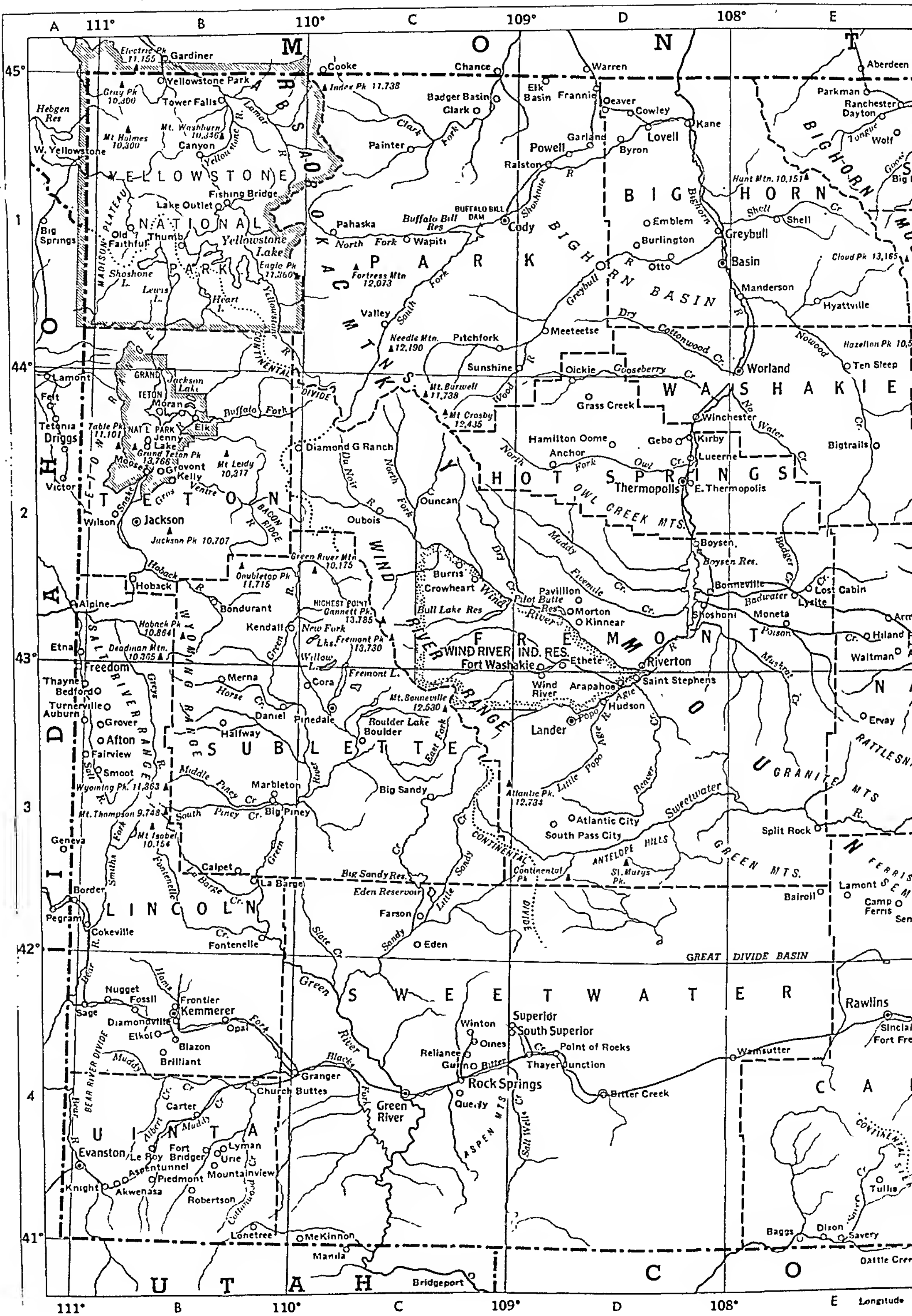
MANY SMALL SAWMILLS HELP WYOMING'S LUMBER INDUSTRY



Scores of small sawmills, such as this one located on Mosquito Creek, send their smoke above the primitive green majesty of the trees of Teton National Forest in western Wyoming. Lumbering is one of the most important industries in the state.



Like a great petrified tree stump, this column of volcanic rock rises 1,200 feet above the Belle Fourche River. It is in the northeastern corner of the state, in the Black Hills region. The tower is 865 feet high from the ridge at its base. The Indians believed that the furrows in its sides were made by bears pursuing maidens who took refuge on its summit. Geologists tell us that it was formed by the upwelling of molten lava, which cooled so rapidly that it shrank and cracked into the form of fluted columns. It was the first national monument (*see* National Parks and Monuments).



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111°
B
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43°
42°
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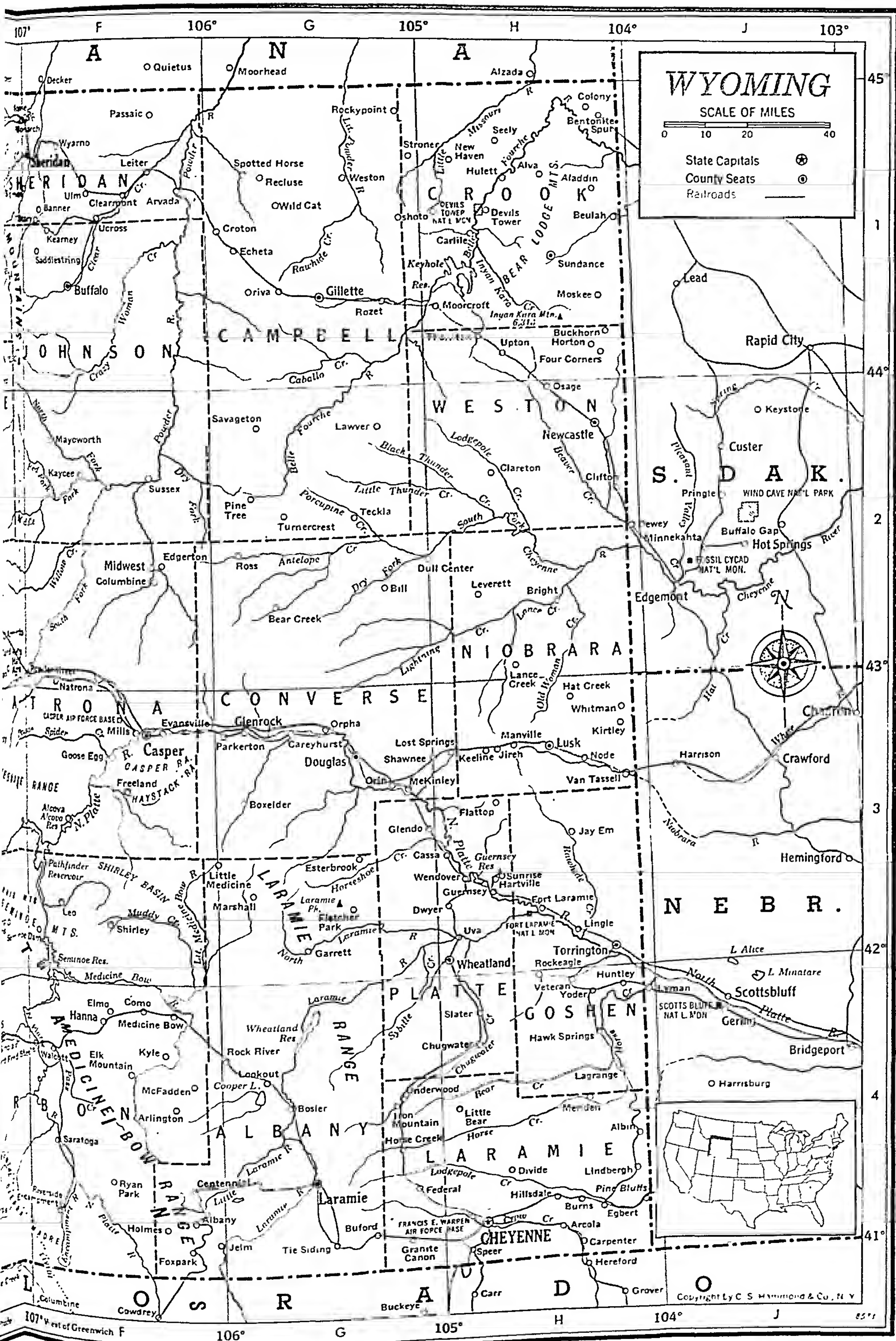
Longitude
YELLOWSTONE
NATIONAL
PARK
Yellowstone Lake
Electric Pk 11,155
Gardiner
Yellowstone Park
Gray Pk 10,300
Tower Falls
Hebgen Res
Mt. Washburn 10,346
Mt Holmes 10,300
Canyon
W. Yellowstone
Fishing Bridge
Lake Outlet
Big Springs
Old Faithful
Thumb
MADISON PLATEAU
Shoshone L.
Lewis L.
Heart L.
Eagle Pk 11,360
Cooke
Index Pk 11,738
Chance
Warren
Elk Basin
Frannie
Deaver
Cowley
Kane
Badger Basin
Clark
Garland
Lovell
Powell
Byron
Painter
Ralston
Clark Fork
Aberdeen
Parkman
Ranchester
Dayton
Tongue
Wolf
BIGHORN
Hunt Mtn. 10,151
Big Horn
BUFFALO BILL DAM
Buffalo Bill Res
Cody
Pahaska
North Fork
Wapiti
PARK
BIG HORN
Emblem
Burlington
Greybull
Shell
Otto
Basin
Cloud Pk 13,165
Manderson
Hyattville
BIGHORN BASIN
Fortress Mtn 12,073
Valley
South Fork
Needle Mtn. 12,190
Pitchfork
Meeteetse
Dry Cottonwood Cr.
Nowood
Hazelton Pk 10,5
Sunshine
Oickie
Gooseberry Cr
Worland
Ten Sleep
WASHAKIE
Grass Creek
Winchester
No Water
Mt. Burwell 11,738
Mt Crosby 12,435
ABSAROKA RANGE
ABSAROKA MTNS
TETON RANGE
GRAND TETON
Jackson Lake
Moran
Buffalo Fork
Lamont
Felt
Tetonia
Driggs
Table Pk 11,101
GRAND TETON NAT'L PARK
Jenny Lake
Grand Teton Pk 13,766
Moose
Grovont
Kelly
Mt Leidy 10,317
Victor
Wilson
Jackson
Jackson Pk 10,707
TETON
Gros Ventre
BACON RIDGE
Hamilton Dome
Anchor
Gebo
Kirby
Lucerne
Bigtrails
North Fork
Owl Cr.
HOT SPRINGS
Thermopolis
E. Thermopolis
OWL CREEK MTS.
Diamond G Ranch
Du Noir
Duncan
Dubois
Boysen
Boysen Res.
Badger Cr
Muddy
Fivemile Cr.
Green River Mtn 10,175
WIND RIVER
Burris
Crowheart
Bull Lake Res
Pavillion
Pilot Butte Res
Morton
Kinnear
Bonneville
Lost Cabin
Badwater
Lysite
Shoshoni
Moneta
Poison
Hiland
Waltman
Hoback
Onubletop Pk 11,715
Alpine
Bondurant
HIGHEST POINT Gannett Pk 13,785
Hoback Pk 10,864
Kendall
New Fork
Fremont Pk 13,730
Etna
Deadman Mtn. 10,365
WYOMING RANGE
Willow L.
Fremont L.
WIND RIVER IND. RES.
Fort Washakie
Ethete
FREMONT
Riverton
Saint Stephens
Freedom
Thayne
Bedford
Turnerville
Auburn
Grover
Afton
Fairview
Smoot
SALT RIVER RANGE
Merna
Horse Cr.
Daniel
Cora
Pinedale
Mt. Bonneville 12,530
Wind River
Arapahoe
Hudson
Lander
Popo Agie
Boulder Lake
Boulder
SUBLETTE
Halfway
East Fork
Middle Piney Cr
Marbleton
Big Sandy
Wyoming Pk. 11,363
Mt. Thompson 9,748
South Piney Cr.
Big Piney
Atlantic Pk. 12,734
Little Popo Agie
Beaver
Sweetwater
Atlantic City
South Pass City
GRANITE MTS
RATTLESNAKE
Ervay
Split Rock
Geneva
Mt Isobel 10,154
Smiths Fork
Fontenelle
Calpet
CONTINENTAL DIVIDE
ANTELOPE HILLS
GREEN MTS.
FERRIS
Big Sandy Res.
Continental Pk
St. Marys Pk.
Bairoil
Lamont
Camp Ferris
Border
La Barge
Eden Reservoir
Little Sandy
Pegram
LINCOLN
Farson
Cokeville
Fontenelle
Slate Cr
Sandy
Eden
GREAT DIVIDE BASIN
Bear R.
Hams Fork
Nugget
Fossil
Frontier
Kemmerer
Sage
Diamondville
Elkol
Opal
Blazon
Brilliant
BEAR RIVER DIVIDE
Green River
SWEETWATER
Winton
Superior
South Superior
Ones
Reliance
Point of Rocks
Gunn
Thayer Junction
Wamsutter
Rawlins
Sinclair
Fort Fred
Granger
Blacks Fork
Church Buttes
Rock Springs
Bitter Creek
Quealy
Carter
Green River
ASPEN MTS
Salt Wells Cr
UINTA
Evanston
Le Roy
Fort Bridger
Lyman
Urie
Muddy Cr
Asentunnel
Mountainview
Knight
Piedmont
Akwenasa
Robertson
CARBON
Tullis
Cottonwood
Lonetree
McKinnon
Manila
Baggs
Dixon
Savery
Battle Creek
Bridgeport


WYOMING
SCALE OF MILES
0 10 20 40
State Capitals
County Seats
Railroads
107° F 106° G 105° H 104° J 103°
45° 44° 43° 42° 41°
1 2 3 4
CANADA
SHERIDAN
JOHNSON
CAMPBELL
CROOK
WESTON
NIOBRARA
CONVERSE
NATRONA
PLATTE
GOSHEN
LARAMIE
ALBANY
CARBON
S. DAK.
NEBR.
COLORADO
Quietus
Moorhead
Decker
Alzada
Colony
Bentonite Spur
Passaic
Rockypoint
Stoner
New Haven
Seely
Wyarno
Sheridan
Leiter
Spotted Horse
Recluse
Weston
Hulett
Alva
Aladdin
Ulm
Clearmont
Arvada
Wild Cat
Banner
Ucross
Croton
Oshoto
DEVILS TOWER NAT'L MON
Devils Tower
Beulah
Kearney
Saddlestring
Echeta
Carlile
Buffalo
Keyhole Res.
Sundance
Oriva
Gillette
Rozet
Moorcroft
Moskee
Inyan Kara Mtn.
Buckhorn
Horton
Upton
Four Corners
Osage
BEAR LODGE MTS.
Lead
Rapid City
Keystone
Custer
Pringle
WIND CAVE NAT'L PARK
Buffalo Gap
Hot Springs
Dewey
Minnekahta
FOSSIL CYCAD NAT'L MON.
Edgemont
Savageton
Lawver
Newcastle
Clareton
Clifton
Maycworth
Kaycee
Sussex
Pine Tree
Turnercrest
Teckla
Midwest
Edgerton
Columbine
Ross
Dull Center
Bill
Leverett
Bright
Bear Creek
Lance Creek
Hat Creek
Whitman
Kirtley
Chadron
Natrona
CASPER AIR FORCE BASE
Evansville
Glenrock
Orpha
Mills
Casper
Parkerton
Careyhurst
Douglas
Lost Springs
Shawnee
Manville
Lusk
Keeline
Jireh
Node
Van Tassell
Harrison
Crawford
Goose Egg
CASPER RA.
HAYSTACK RA.
Freeland
Orin
McKinley
Alcova
Alcova Res
Boxelder
Flattop
Glendo
Jay Em
Hemingford
Pathfinder Reservoir
SHIRLEY BASIN
Little Medicine
Esterbrook
Cassa
Guernsey Res
Sunrise
Hartville
Wendover
Guernsey
Fort Laramie
Marshall
Laramie Pk.
Fletcher Park
Dwyer
Lingle
Leo
Shirley
Uva
FORT LARAMIE NAT'L MON
Torrington
Garrett
Wheatland
Rockeagle
L. Alice
L. Minatare
Seminoe Res.
Huntley
Veteran
Yoder
Lyman
Scottsbluff
SCOTTS BLUFF NAT'L MON
Gering
Elmo
Como
Hanna
Medicine Bow
Wheatland Res
Slater
Hawk Springs
Bridgeport
Kyle
Elk Mountain
Rock River
Chugwater
Lagrange
Lookout
Cooper L.
McFadden
Harrisburg
Underwood
Bosler
Arlington
Iron Mountain
Little Bear
Meriden
Albin
Saratoga
Horse Creek
Divide
Lindbergh
MEDICINE BOW RANGE
LARAMIE RANGE
Ryan Park
Centennial
Laramie
Federal
Hillsdale
Pine Bluffs
Burns
Egbert
Albany
Buford
FRANCIS E. WARREN AIR FORCE BASE
Arcola
Holmes
Jelm
Tie Siding
Granite Canon
CHEYENNE
Carpenter
Speer
Foxpark
Hereford
Carr
Grover
Columbine
Cowdrey
Buckeye
107° West of Greenwich
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WYOMING

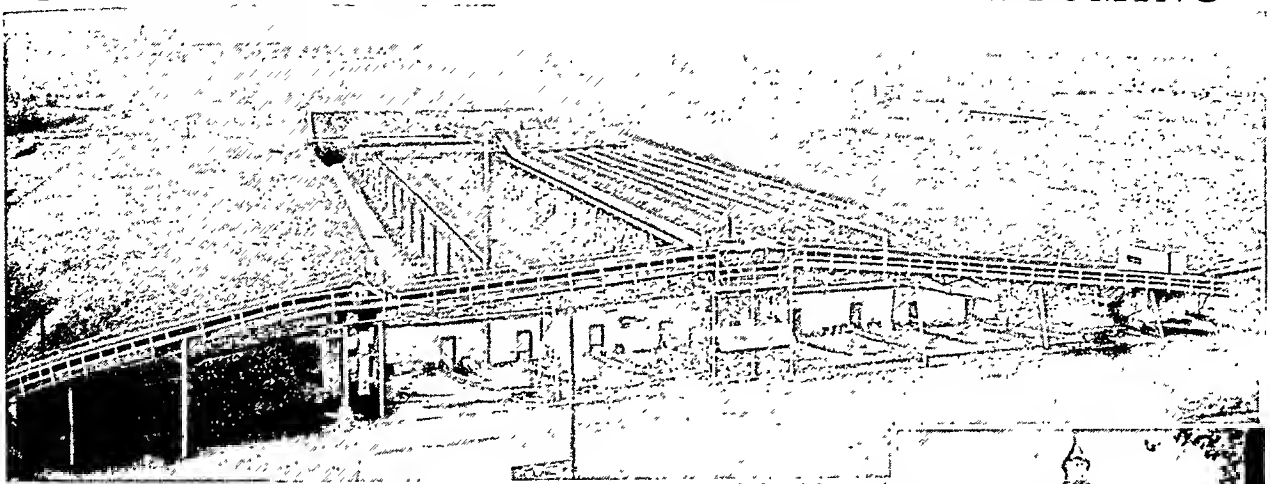
COUNTIES

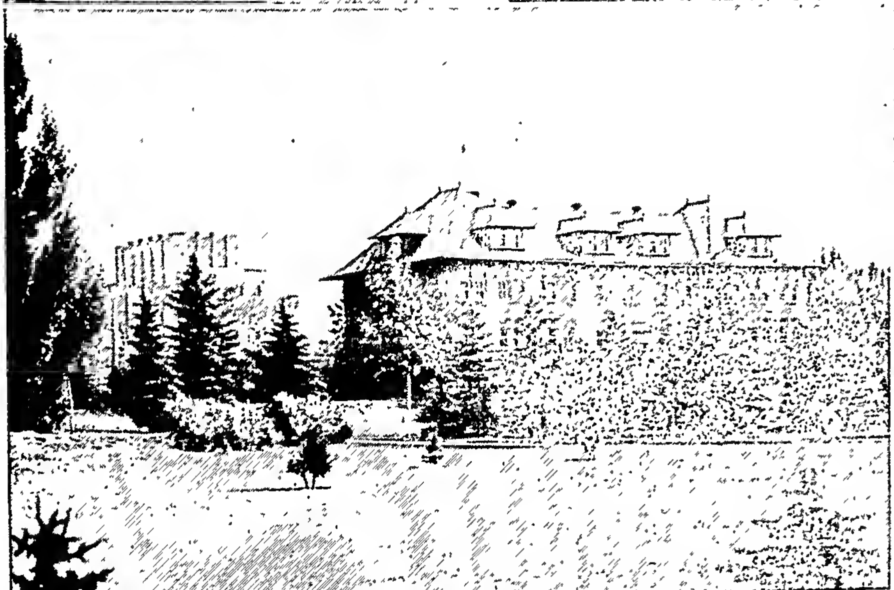
Albany	19,055	G 4
Big Horn	13,176	E 1
Campbell	4,839	G 1
Carbon	15,742	F 4
Converse	5,933	G 3
Crook	4,738	H 1
Fremont	19,580	D 2
Goshen	12,634	H 4
Hot Springs	5,250	D 2
Johnson	4,707	F 1
Laramie	47,662	H 4
Lincoln	9,023	B 3
Natrona	31,437	F 3
Niobrara	4,701	H 2
Park	15,182	C 1
Platte	7,925	H 4
Sheridan	20,185	F 1
Sublette	2,481	C 3
Sweetwater	22,017	D 4
Teton	2,593	B 2
Uinta	7,331	B 4
Washakie	7,252	E 2
Weston	6,733	H 2
Yellowstone Nat'l Park	353	B 1

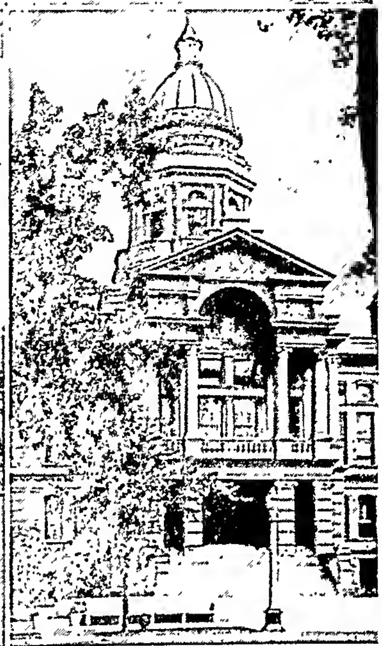
CITIES AND TOWNS

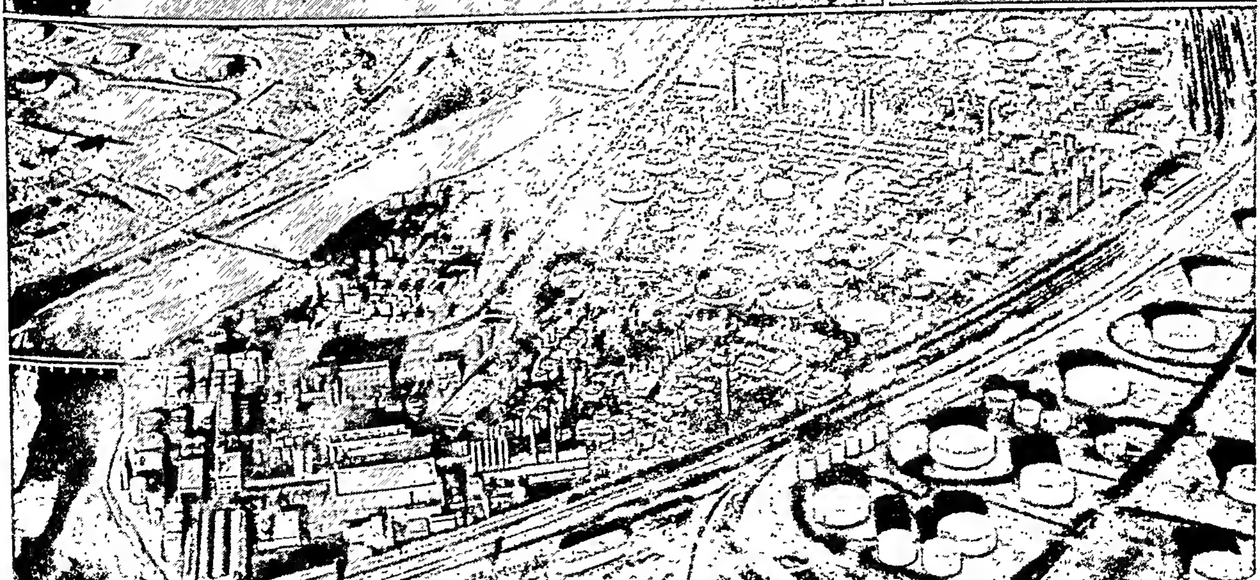
Acme	200	E 1
Afton	1,319	B 3
Akwenasa	50	B 4
Aladdin	10	H 1
Albany	50	F 4
Albin	208	H 4
Alcova	36	F 3
Alva	51	H 1
Anchor		D 2
Arapahoe	193	D 3
Arcola	15	H 4
Arlington		F 4
Arminto	30	E 2
Arvada	85	F 1
Aspentunnel	20	B 4
Atlantic City	20	D 3
Auburn	400	A 3
Badger Basin		C 1
Baggs	206	E 4
Bairoil	300	E 3
Banner	4	F 1
Basin	1,220	E 1
Bear Creek	6	G 2
Bedford	268	A 3
Bentonite Spur	12	H 1
Beulah	50	H 1
Big Horn	200	E 1
Big Piney	206	B 3
Big Sandy	20	C 3
Bigtrails		E 2
Bill	6	G 2
Bitter Creek	150	D 4
Blazon		B 4
Bondurant	6	B 2
Bonneville	75	E 2
Border	35	B 3
Bosler	75	G 4
Boulder	20	C 3
Boxelder		G 3
Boysen	100	D 2
Bright	4	H 2
Brilliant	15	B 4
Buckhorn	5	H 1
Buffalo	2,674	F 1
Buford	62	G 4
Burlington	150	D 1
Burns	216	H 4
Burris	90	C 2
Byron	350	D 1
Calpet	79	B 3
Camp Ferris	20	E 3
Canyon		B 1
Careyhurst		G 3
Carlile	2	H 1
Carpenter	104	H 4
Carter	75	B 4
Casper	23,673	F 3
Cassa	10	G 3
Centennial	68	F 4
CHEYENNE	31,935	H 4
Chugwater	283	H 4
Church Buttes	75	B 4
Clareton	3	H 2
Clark	100	C 1
Clearmont	225	F 1
Clifton	5	H 2
Cody	3,872	D 1
Cokeville	440	B 3
Colony		H 1
Columbine	40	F 2
Como	6	F 4
Cora	4	C 3
Cowley	463	D 1
Croton		G 1
Crowheart	4	C 2
Daniel	75	B 3
Dayton	316	E 1
Deaver	118	D 1
Devils Tower	30	H 1
Diamond G Ranch		C 2
Diamondville	415	B 4
Dickie	35	D 1
Dines	237	C 4
Divide	2	H 4
Dixon	124	E 4
Douglas	2,544	G 3
Dubois	279	C 2
Dull Center	8	H 2
Duncan	17	C 2
Dwyer	16	G 3
E. Thermopolis	246	D 2
Echeta		G 1
Eden	200	C 3
Edgerton	203	F 2
Egbert	50	H 4
Elk	34	B 2
Elk Basin	200	D 1
Elk Mountain	196	F 4
Elkol	40	B 4
Elmo	213	F 4
Emblem	250	D 1
Encampment	288	F 4
Ervay	3	E 3
Esterbrook	15	G 3
Ethete	50	D 2
Etna	450	A 2
Evanston	3,863	B 4
Evansville	393	F 3
Fairview	400	B 3
Farson	150	C 3
Federal	10	H 4
Fishing Bridge		B 1
Flattop	2	H 3
Fletcher Park	5	G 3
Fontenelle	35	B 3
Fort Bridger	100	B 4
Fort Fred Steele	40	E 4
Fort Laramie	300	H 3
Fort Washakie	1,500	C 2
Fossil	10	B 4
Four Corners	30	H 1
Foxpark	110	F 4
Frannie	180	D 1
Freedom	510	B 3
Freeland	5	F 3
Frontier	500	B 4
Garland	60	D 1
Garrett	29	G 3
Gebo	200	D 2
Gillette	2,191	G 1
Glendo	215	G 3
Glenrock	1,110	G 3
Goose Egg	20	F 3
Granger	122	C 4
Granite Canon	120	G 4
Grass Creek	150	D 2
Green River	3,187	C 4
Greybull	2,262	E 1
Grover	350	B 3
Grovont		B 2
Guernsey	721	H 3
Gunn		C 4
Halfway	25	B 3
Hamilton Dome	187	D 2
Hanna	1,326	F 4
Hartville	229	H 3
Hat Creek	1	H 3
Hawk Springs	163	H 4
Hells Half Acre	6	E 2
Hiland	7	E 2
Hillsdale	78	H 4
Hoback	5	B 2
Holmes	25	F 4
Horse Creek	10	G 4
Horton		H 1
Hudson	293	D 3
Hulett	236	H 1
Huntley	69	H 4
Hyattville	125	E 1
Iron Mountain	23	G 4
Jackson	1,244	B 2
Jay Em	30	H 3
Jelm	2	G 4
Jenny Lake	7	B 2
Jireh	7	H 3
Kane	21	D 1
Kaycee	211	F 2
Kearney	11	F 1
Keeline	17	H 3
Kelly	18	B 2
Kemmerer	1,667	B 4
Kendall	8	B 2
Kinnear	32	D 2
Kirby	99	D 2
Kirtley		H 3
Knight	12	B 4
Kyle	30	F 4
La Barge	110	B 3
Lagrange	221	H 4
Lake Outlet		B 1
Lamont	100	E 3
Lance Creek	2,000	H 2
Lander	3,349	D 3
Laramie	15,581	G 4
Lawver	2	G 2
Le Roy	15	B 4
Leiter	3	F 1
Leo	41	F 3
Leverett		H 2
Lindbergh	5	H 4
Lingle	403	H 3
Little Bear		H 4
Little Medicine	6	G 3
Lonetree	70	B 4
Lookout	15	G 4
Lost Cabin	73	E 2
Lost Springs	9	G 3
Lovell	2,508	D 1
Lucerne	13	D 2
Lusk	2,089	H 3
Lyman	483	B 4
Lysite	50	E 2
Manderson	107	E 1
Manville	154	H 3
Marbleton	20	B 3
Marshall	20	G 3
Mayoworth	5	F 2
McFadden	225	F 4
McKinley	21	G 3
McKinnon	154	C 4
Medicine Bow	328	F 4
Meeteetse	404	D 1
Meriden	16	H 4
Merna	50	B 3
Midwest	2,000	F 2
Mills	866	F 3
Monarch	500	F 1
Moneta	12	E 2
Moorcroft	517	H 1
Moose	65	B 2
Moran	120	B 2
Morton	18	D 2
Moskee	70	H 1
Mountainview		B 4
Natrona		F 2
New Haven		H 1
Newcastle	3,395	H 2
Node	4	H 3
Nugget	10	B 4
Old Faithful		B 1
Opal	67	B 4
Orin	50	G 3
Oriva		G 1
Orpha	40	G 3
Osage	284	H 2
Oshoto	7	G 1
Otto	400	D 1
Pahaska	50	C 1
Painter	35	C 1
Parkerton	90	G 3
Parkman	75	E 1
Passaic	5	F 1
Pavillion	241	D 2
Piedmont	29	B 4
Pine Bluffs	846	H 4
Pine Tree		G 2
Pinedale	770	C 3
Pitchfork	50	C 1
Point of Rocks	46	D 4
Powder River	42	F 2
Powell	3,804	D 1
Quealy	147	C 4
Ralston	64	D 1
Ranchester	251	E 1
Rawlins	7,415	E 4
Recluse	21	G 1
Reliance	700	C 4
Riverside	50	F 4
Riverton	4,142	D 2
Robertson	24	B 4
Rock River	424	G 4
Rock Springs	10,857	C 4
Rockeagle	2	H 3
Rockypoint	4	G 1
Ross	25	G 2
Rozet	50	G 1
Ryan Park	150	F 4
Saddlestring	10	F 1
Sage	25	B 4
St. Stephens	150	D 3
Saratoga	926	F 4
Savageton		G 2
Savery	55	E 4
Seely	5	H 1
Seminoe Dam	59	E 3
Shawnee	25	G 3
Shell	61	E 1
Sheridan	11,500	F 1
Shirley	20	F 3
Shoshoni	891	D 2
Sinclair	775	E 4
Slater	12	H 4
Smoot	280	B 3
S. Pass City	15	D 3
S. Superior	780	D 4
Speer	10	H 4
Spotted Horse	4	G 1
Story	335	F 1
Stroner	3	H 1
Sundance	893	H 1
Sunrise	450	H 3
Sunshine		C 1
Superior	1,580	D 4
Sussex		F 2
Teckla	9	G 2
Ten Sleep	289	E 1
Thayer Junction	37	D 4
Thayne	229	A 3
Thermopolis	2,870	D 2
Thornton		H 1
Thumb		B 1
Tie Siding	50	G 4
Torrington	3,247	H 4
Tower Falls		B 1
Tullis	3	E 4
Turnercrest	10	G 2
Turnerville	73	A 3
Ucross	45	F 1
Ulm	45	F 1
Underwood	10	G 4
Upton	951	H 1
Urie	25	B 4
Uva	35	H 3
Valley	100	C 1
Van Tassell	34	H 3
Veteran	48	H 4
Walcott	25	F 4
Waltman	6	E 2
Wamsutter	103	E 4
Wapiti	13	C 1
Wendover	30	H 3
Weston	2	G 1
Wheatland	2,286	H 3
Whitman	2	H 3
Wild Cat	2	G 1
Wilson	200	B 2
Winchester	57	D 2
Wind River	300	D 3
Winton	665	C 4
Wolf	75	E 1
Worland	4,202	E 1
Wyarno	6	F 1
Yellowstone Park	250	B 1
Yoder	128	H 4

INDUSTRIES AND INSTITUTIONS OF WYOMING







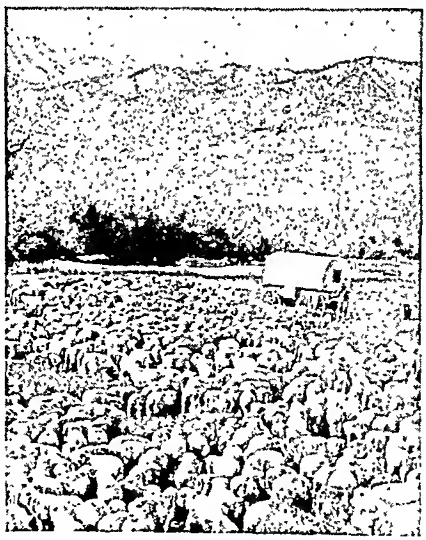


At the top and bottom of the page are glimpses of two leading sources of wealth in Wyoming—sugar beets and petroleum. The top picture shows a storage yard where sugar beets are held until the sweet juice can be extracted and refined. The petroleum storage and refining plant is at Casper, in the east central part of the state. The two middle pictures show (left) a glimpse of the University of Wyoming, at Laramie, and (right) the central portion of the State Capitol at Cheyenne. The University buildings are Merica Hall, a dormitory for women, and in the background, the Liberal Arts building. The Capitol is cherished as a monument to pioneer foresight and enterprise. Construction was authorized in 1886, when Wyoming was still a territory, and the building was completed just in time to be used when Wyoming was admitted to the Union in 1890.

THE "OPEN RANGE" STILL PRODUCES WEALTH

Cheyenne, the capital and largest city, situated in the southeastern corner of the state, is one of the chief cattle centers of the West. Its annual Frontier Days' Celebration revives the life of the Old West. Cheyenne citizens dress up in traditional costume; the Sioux Indians come in from the reservations to dance; and cowboys and cowgirls participate in the rodeo contests. The city has railroad and airplane repair shops, an oil refinery, and a meat-packing plant (*see* Cheyenne).

Casper, near the center of the state, is second in size. Most of its growth has been due to its huge oil refineries and central location in wool-producing areas. Laramie, about 51 miles northwest of Cheyenne, stands on the Laramie plains, between two mountain ranges. It is a summer resort and shipping center for cattle and sheep. The state university is located here. Sheridan, near the northern boundary of the state, lies in the midst of a farming, livestock-raising, and mining region. Rock Springs, in the southwestern part of Wyoming, is the center of a district producing coal, petroleum, and natural gas.



In the upper picture cattle are moving across unfenced grazing land, just as they did in the pioneer days of the livestock industry. The lower picture shows a sheepherder's lonely wagon home in the midst of his flock.

History of Wyoming

Wyoming came to the United States as part of the Louisiana Purchase. Only a few explorers and fur traders had crossed its present boundaries before the 19th century. Fort Laramie was founded as a trading post in 1834. After Gen. John C. Frémont's expedition to the Wind River Mountains and over the South Pass in 1842, the favorite routes to the Pacific led through southern Wyoming.

Of the thousands who passed over the famous Oregon and Overland trails few settled permanently, because of the aridity of the land and the hostility of the Sioux Indians. James Bridger built Fort Bridger in 1843. A Mormon settlement was made on the Green River in 1853 but was soon abandoned in favor of Salt Lake City. Gold was discovered on the Sweetwater River in 1867, and a large inrush of people founded South Pass City. In the same year Cheyenne was laid out by the Union Pacific Railroad. Laramie followed in 1868, and both towns were populated almost immediately.

In 1868 Congress established Wyoming Territory, taking land from the territories of Dakota, Utah, and Idaho. The first legislature met in 1869 and granted full suffrage to men and women. The history of the territory was marked by Indian wars. These lasted until the Indians were confined to reservations. Wyoming became a state in 1890. (*See also* chronology in Wyoming Fact Summary; United States, sections "Great Plains" and "Rocky Mountains.")

X

XAVIER (*zăv'ĭ-ẽr*), SAINT FRANCIS (1506–1552). In the long and glorious annals of Christian missions there is no more inspiring page than that which tells of the devoted labors of Saint Francis Xavier, the "Apostle of the Indies." The hardships he underwent in 11 years of incessant travel through India, the East Indies, and Japan, and the results he achieved in carrying the Gospel to remote regions where the name of Christ had never before been heard give ample warrant for the view that he should be regarded as the greatest of Christian missionaries since the first century A.D. It is said that his travels in heathen lands covered 50,000 miles and that he baptized more than half a million persons.

A gifted youth, the youngest son of a noble family of Spanish Navarre, he began his studies in 1524 at the University of Paris, where after a few years he became a lecturer. Love of learning and love of pleasure occupied his thoughts until he met Ignatius Loyola, the founder of the Jesuit order, who often quoted to him the words, "What shall it profit a man if he gain the whole world and lose his own soul?" Loyola's solemn pleadings sank into Francis' heart and inspired him to give his life to holy things. In 1534 he joined Loyola and others in forming the small band which the pope sanctioned as the Society of Jesus (Jesuits) in 1540. (*See also* Loyola; Reformation.)


SAINT FRANCIS XAVIER
The "Apostle of the Indies"

Francis Xavier was ordained a priest in 1537; he studied medicine, tended the sick in hospitals, and preached wherever men would listen to him. In 1541 he began the missionary career in which he spent the remaining years of his life, being sent with the rank of papal nuncio to preach the Gospel in India. On the way he lived among the common sailors, ministering to their spiritual needs and caring for them during an attack of scurvy. Landing at Goa, on the west coast of India, he labored there for several months, then began a series of remarkable journeys which covered the whole of India, the scattered islands along the coast, Malacca, and the Moluccas or Spice Islands far to the east. Finally he went to Japan, where he remained more than two years, penetrating into all parts of the country, winning many converts to the faith. His next plans were for the conversion of China, but he fell ill of fever on the way and died on the island of Sancian, near Canton, at the age of 46. He was canonized in 1622 by Pope Gregory XV as Saint Francis Xavier, and December 3 was fixed as his feast day.

XENOPHON (*zĕn'ō-fŏn*) (about 430–355 B.C.). To a boy or girl who studies Greek, Xenophon always means first of all the author of the 'Anabasis', in whose pages we read of the "upward march" (Greek, *anabasis*) and long and trying retreat of the famous Ten Thousand Greeks who entered the service of the unfortunate Cyrus the Younger against the king of Persia. To us also comes a thrill as we read the cry, *Thalassa! Thalassa!*—"The sea! The sea!" with which the worn and wearied band, heroic in defeat, greeted at last the saving waters which should carry them home again.

This expedition, of which Xenophon was a member and the historian, set out in 401 B.C. He was an Athenian and had been a pupil of Socrates, whose life he is said to have saved in the battle of Delium. When he returned to Athens in 399, he found his old teacher condemned to death, and wrote the 'Memorabilia' (Recollections of Socrates) to clear the memory of the great philosopher of the charges on which he was executed.

For a time Xenophon even served Sparta in war against Athens, so great was his wrath at his native city. For 20 years he lived on an estate in Elis, given him by the Spartans, busying himself with agriculture and literary work.

Besides the 'Anabasis' and 'Memorabilia', Xenophon's chief works are: 'Hellenica', a history of Greece from 411 to 362 B.C.; 'Cyropedia', a political and philosophical romance describing the education of Cyrus the Great, king of Persia.

XIMENES (*zĭ-mē'nēz*) **DE CISNEROS**, CARDINAL (1436–1517). At the very time when Isabella of Castile was aiding Columbus to set out upon his memorable voyage, she was also raising from obscurity a monk who wore the humble habit of the Gray or Franciscan friars. For many years this tall gaunt friar had been leading a life of severe asceticism in an obscure monastery, and the fame of his penitential life and great holiness had traveled wide. In 1492 Queen Isabella called him to her court and appointed him royal confessor; and although he was then 56 years old, he rose rapidly to a pinnacle of greatness to which few can aspire.

Educated at the university of Salamanca, Francisco Ximenes, or Jiménez (*hē-mā'nāth*, as the Spaniards write and pronounce it), spent several years of his early life at Rome, and then returned to Spain to receive an appointment given him by the pope. But the archbishop of Toledo refused to recognize the

pope's grant, and became so incensed at Ximenes' insistence that he cast him into prison, where he remained for six years. Released from prison, he gained an important position in the church, but soon renounced it to enter the order of Franciscans.

Upon the death of the Cardinal-Archbishop Mendoza of Toledo (not his former enemy) in 1495, the Queen secured from the pope the appointment of Ximenes to this post, the richest and most powerful in the whole Spanish church. Ximenes at first refused the position, for he did not desire earthly honors, but finally accepted it after receiving express orders from the pope. Twelve years later he was also made cardinal. As archbishop of Toledo he applied himself seriously to reforms among the clergy and religious orders; and although maintaining the outward forms of splendor which his position demanded, continued to lead the simple life of a Franciscan friar.

Shortly after his accession be began to devote himself to the chief aim of his existence, the conversion of the Moors. His stern methods were attended with considerable success, and in 1505 he extended his efforts to Africa, himself leading a brilliant expedition which in one day took the city of Oran. Since the death of Isabella, in 1504, Ximenes had played a considerable part in the government of Castile; and on the death of her husband Ferdinand of Aragon, in 1516, he became regent of all Spain for the young king Charles (*see* Charles V). In the two years during which Ximenes held this position he showed himself a bold and determined statesman. He established a standing army by drilling the citizens of the principal towns, increased the maritime power of Spain, and yet paid off the national debt.

Ximenes will probably be best remembered, however, for his founding of the great University of Alcala in 1508; and for his famous "Complutensian Polyglot" Bible, which was printed there at his expense, on the plan of exhibiting in one view the scriptures in their various ancient languages. This contained the first printed text of the original Greek of the New Testament, although it happened that the Greek edition annotated by the Dutch scholar Erasmus was the first published (*see* Bible).

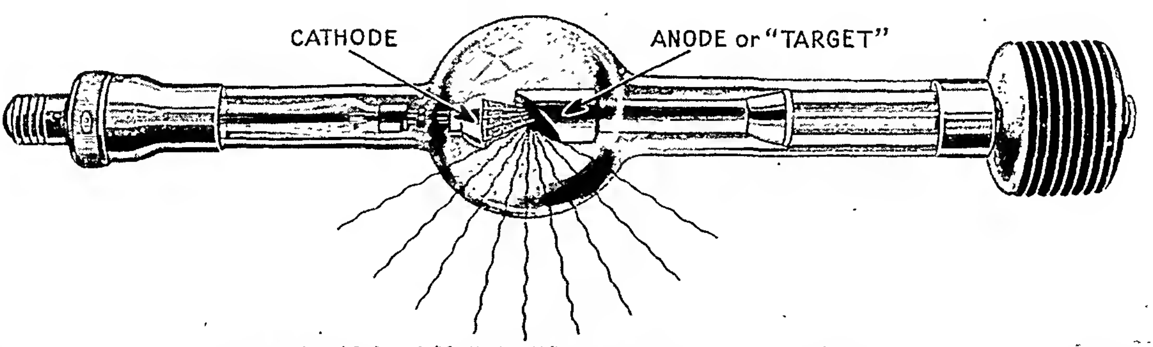
RAYS *that* SHOOT *Through* SOLID MATTER

The Mysterious Streams of Energy by Whose Power We Can See Into the Human Body—Their Discovery by Professor Roentgen, and How They Are Used in Medicine and Other Fields

X-RAYS. The use of "X," symbol of the unknown, in the name of these rays which can reveal conditions inside living bodies, and can detect flaws buried deep in solid metal castings, is thoroughly appropriate. Although we now have definite ideas concerning the nature of these rays, for many years after their discovery—even while they were being used the world over in medicine and science—their nature was a mystery. Moreover, even now when we understand them better, much that they do seems so uncanny that the term "X" seems quite appropriate for these rays.

The story of these fascinating rays started about the middle of the 19th century, when Heinrich Geissler (1814–1879) and others found that discharging electricity under high voltage through tubes containing a partial vacuum produced beautiful light effects. The most fruitful investigations made upon this effect were those of Sir William Crookes (1832–1919). He obtained high vacuums in his tubes, and by using concave cathodes (the cathode is the electrode by which current leaves the tube) and metal screens and slits within his tubes, he obtained beamlike effects

THE COOLIDGE X-RAY TUBE



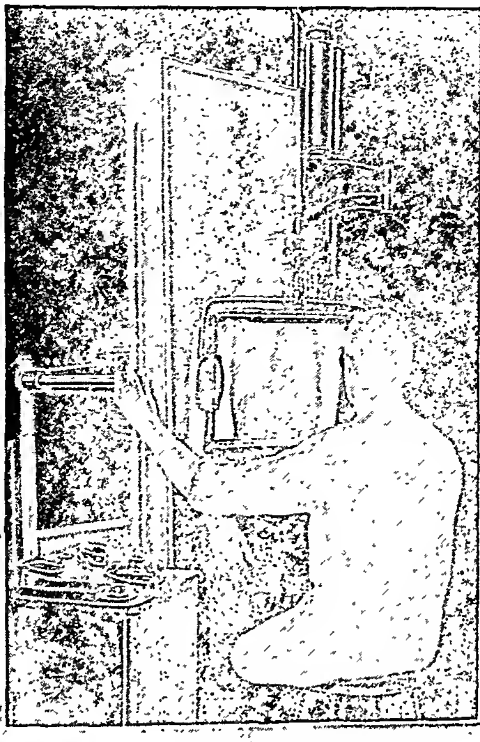
The cup-shaped cathode focuses a stream of electrons, called the cathode rays, against the heavy tungsten target. This causes the target to produce the penetrating X-rays which come out through the glass of the tube. A Coolidge tube of this kind is made with the highest possible vacuum, and the electrons have to be supplied by a filament situated behind the cathode and heated, like the filament of a radio tube, by an independent low-voltage current. The potential between cathode and anode which drives the electron stream often exceeds 100,000 volts, and in special types exceeds 1,000,000 volts. The finned radiator at the right helps to carry away the intense heat generated on the target by the impact of the electrons.

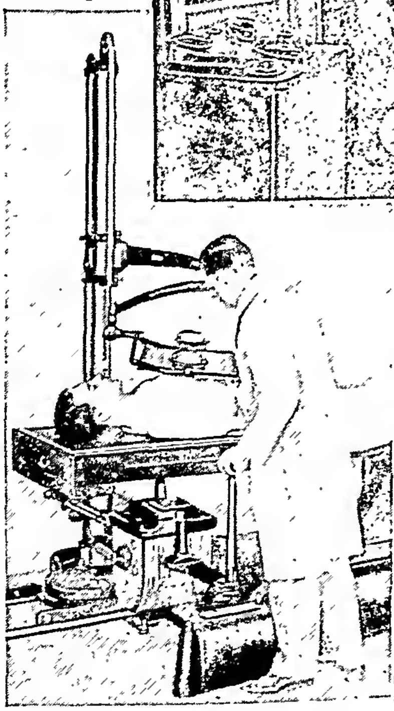
which indicated that the luminosity was caused by electrified particles streaming from the cathode. Heinrich Hertz (1857–1894) showed that Crookes' "cathode rays" would pass through thin sheets of gold or platinum, and his pupil P. E. A. von Lenard added "windows" of such substances to the Crookes' tube, so rays could pass through to the outer air.

Thus the stage unwittingly was set for the discovery, in 1895, of the X-ray. In that year Prof. Wilhelm Roentgen (1845–1923), experimenting with a Crookes' tube at Würzburg, noticed that near-by crystals of barium platinocyanide were glowing brilliantly. Knowing that cathode rays themselves could not pass through the glass to produce this effect, he immediately suspected that some other kind of rays was present. He exposed photographic plates near the tube and found they became fogged. Plates wrapped in black paper were affected just as if no paper were around them. Astonished by this result, Roentgen decided that here was an invisible ray, hitherto unknown, differing in important respects both from the cathode ray which produced it, and from light. He named this newly discovered form of radiation "X-rays"—the "rays of unknown nature." Later on scientists called them Roentgen rays, a name still largely used in Europe.

The story of Roentgen's amazing discovery spread over the world immediately by telegraph and cable. Its medical value was at once recognized when experiments showed that these rays would penetrate flesh, and the use of X-rays in this and other fields developed amazingly, as will be told later. Meanwhile scientists attempted to learn what these mysterious rays might be; but it was not until 1912, when investigators obtained X-ray spectra by using crystals, as will be explained later, that scientists considered the problem as at all settled. But meanwhile discoveries in other fields were strongly suggesting the answer, based on the nature of cathode rays.

HOW DOCTORS "SEE THROUGH" A MAN





A fluoroscope examination is shown in the upper picture. The X-rays coming through the man's body from behind throw shadows of his bones and organs on the fluorescent screen. At the left is a movable X-ray table being used for a fluoroscope examination. The X-ray tube is in the movable housing underneath, shielded with lead so the rays can escape only through the small opening. In making a radiograph the tube is placed over the patient and the photographic film contained in a special holder is slid into position under the table. At the right is a radiograph which shows the strange taste of a small child for tacks and nails. It shows the stomach and intestines after the child spent an afternoon playing with the things found in the family toolchest as the X-ray showed them.

Cathode rays, many investigators found, are not rays like those of light or radio, which have wavelike characteristics. They consist of billions of electrons—particles of matter, electrical in nature—fired from the cathode through the space in the tube to the anode, in response to the high electric potential differences used. The early experimenters found that this stream of electrons could be deflected by near-by magnets. Since light beams were not so affected, this led scientists to suspect that cathode rays consisted of electrically-charged particles. These particles or electrons moved, they decided, from the cathode to the anode at speeds controlled by the voltage of the current and the degree of vacuum in the tube. Speeds up to 150,000 miles a second were attained in powerful tubes. (The use of terms like anode and cathode, implying the use of direct current, and the fact that alternating current devices, such as Ruhmkorff coils, were often used to actuate the tubes, is not really a contradiction. The effective part of the current so obtained was the higher-tension, single-direction current generated on the "breaks" of current in the primary of the coil.)

From these facts, and expanding knowledge of radioactivity phenomena (*see* Radioactivity), it was easy to suppose that when these flying electrons struck the atoms of the target, some of the target's atoms were

disrupted momentarily, and electrons were jarred loose. These electrons could be supposed to fall back again, while the electronic disturbance would cause radiation into space in a form akin to light. The fact that X-rays were invisible to the eye could be explained by saying that their wave-length was much shorter, lying between the wave-lengths of ultra-violet and that of radium gamma rays (*see* Radiation). This supposition was strengthened by the fact that X-rays, like light waves or rays, were not deflected by magnetic fields.

X-Ray Spectroscopy

The problem was considered settled, at least in broad outline, by the work of the Braggs, von Laue, and Moseley, with first results announced in 1912. They found that X-rays falling upon crystalline substances were diffracted. This was acceptable proof that X-rays were radiant energy like light and not streams of electrons like cathode rays. Under suitable conditions these diffracted rays can be focused on a photographic plate, where they produce patterns as characteristic of the crystalline substances used as are the patterns furnished by the spectroscope (*see* Spectrum and Spectroscope). These patterns depend upon the atomic structure of the substance, and by carefully measuring and analyzing them, scientists have been able to learn much about atomic arrangement. This method of analyzing the structure of substances is called "X-ray spectroscopy."

Since then many puzzles have arisen; but the explanation given will serve for an elementary understanding of what X-rays are, and no definite answer to problems of more advanced nature could be given in simple terms, for practically every answer suggested is open to question in one or more respects.

Why X-Rays Penetrate Objects

Practical uses of X-rays turn largely upon their penetrating power, which is shared to a lesser degree by the longer ultra-violet rays and to a greater degree by the shorter cosmic rays. This penetrating power of X-rays can be demonstrated by the same phenomenon that led Roentgen to discover them. Certain chemicals have the quality of *fluorescing*, or glowing, when X-rays strike them. If a plate covered with calcium tungstate or zinc sulphide, for instance, is held on one side of a human hand, and an X-ray tube is operating on the other side, the bones of the hand will be outlined on the plate as shadows. Such a device is known as a *fluoroscope*. The X-rays do not penetrate the denser bone structure as intensely as they do the flesh, and consequently the bones show up as shadows on the plate. Another way to demonstrate this penetrating power is the other method used by Roentgen—permitting the X-rays to fall on a photographic plate after passing through the subject. These plates are sensitive to X-rays as well as to visible light, and when developed disclose a shadow picture, called a *radiograph*, of the subject.

The density of a substance determines the depth to which X-rays will penetrate it. The rays pass readily through organic tissues such as flesh, the soft green tissue of plants, and smooth-grained wood, because the molecules and atoms forming them are packed loosely, making it easy for the short waves of the X-rays to pass between the particles. Other substances such as bone, teeth, and knots of wood, have a closer structure and the rays are partially blocked. Substances like rock and metal offer still greater resistance. Some materials, like lead, platinum, iridium, osmium, and uranium, are so dense, the molecules being so closely packed, that the X-rays pass through them only if the metals are in thin sheets. Consequently these materials are used as shields to block the passage of X-rays.

X-radiation consists of waves of widely differing attributes. Long or so-called "soft" X-rays do not penetrate things as easily as the shorter or "hard" rays. The faster the speed of the electrons fired from the cathode of the tube the more powerful are the X-rays produced.

How X-Rays Help Doctors

The chief use of these wonderful X-rays is to enable physicians, surgeons, and dentists to examine the inside of the body in diagnosing disease. A modern doctor, wishing to know, for example, the exact facts about the digestive condition of a patient, gives him an *opaque meal* of a harmless bismuth or barium compound. This inert material is so dense to the X-rays that it shows clearly on both the fluoroscope and the radiograph. The shape and position of the stomach and intestines can plainly be seen as this opaque meal moves through the body. A moving-picture camera can be used to record successive stages as they appear on a fluorescent screen. One of the greatest uses for X-ray is in the fight against tuberculosis. Inexpensive portable X-ray machines make it possible to diagnose tuberculosis in a high percentage of cases before the disease reaches an advanced stage. Modern X-ray technicians X-ray the flesh as well as internal organs by coating the skin with a lead oxide ointment.

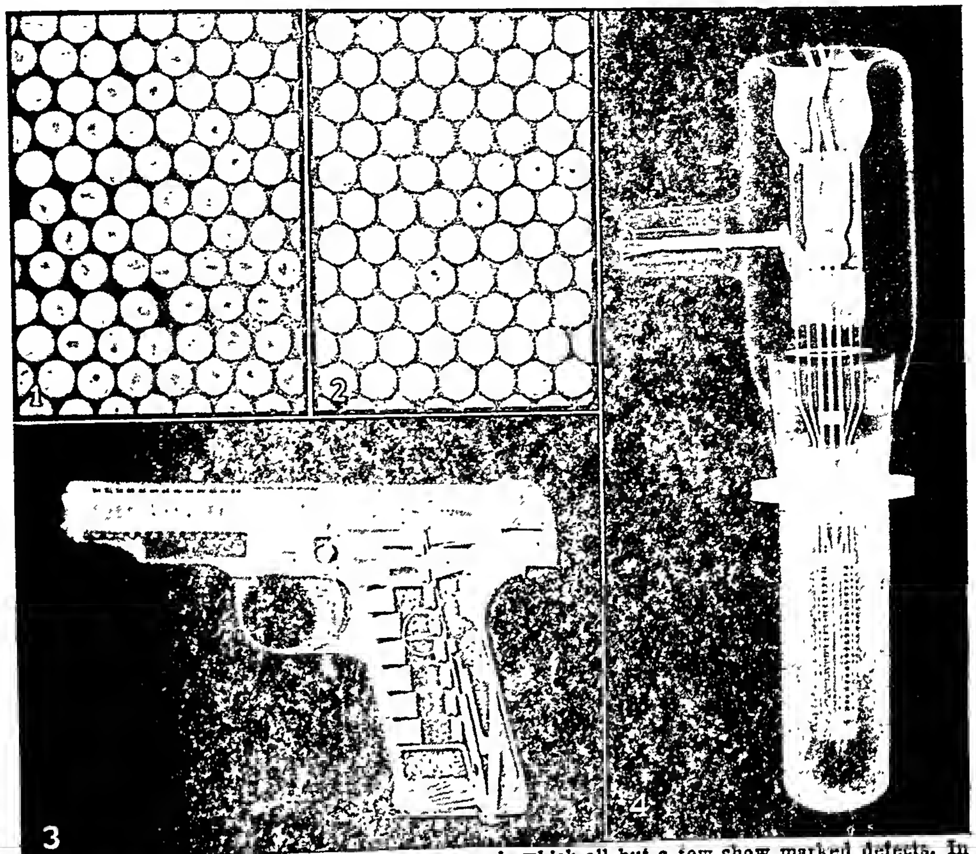
Dentists take X-ray pictures to determine the condition of teeth and jaws. They help to find abscesses and other infections, to decide exactly which teeth should be pulled or treated, and often provide information far in advance of warning pains in the tooth itself. By long experience roentgenologists are able to detect abnormalities in deeply seated organs merely by the slight differences in the shadows made by them. Stereoscopic views showing depth are an important development.

For some time after the discovery of X-rays it was not fully understood that they have profound and marked effect on living tissues. This has been both a benefit and a grave danger. On the one hand, they have been used to destroy cancer tissue and to treat other diseased conditions; on the other hand, when applied too long or too intensely they have caused great damage. In the early days, many of those who experimented with X-rays were overtaken, months and even years later, by the effects of the "burns."

usually in the form of skin cancers on hands, arms, and face. Today, fortunately, it is possible to minimize and in most cases entirely avoid these dangers, both by surrounding the X-ray apparatus with metal shields and by regulating the time, intensity, and extent of the treatment or exposure.

These strange rays can change the very nature of living things. X-ray-treated plant and animal cells have produced monsters and abnormalities of many kinds. For example, the rays have caused changes or "mutations" in the color of flowers and even in the shape of their leaves. Professor Hermann J. Muller of the University of Indiana won the 1946 Nobel prize for discovering this effect of X-rays in 1927.

THE DETECTIVE OF INDUSTRY



The radiograph in 1 shows a tray of ball bearings in which all but a few show marked defects. In 2 the manufacturing process has been improved to a marked extent and the number of defective bearings reduced. In 3 is shown an automatic pistol, loaded and ready for use. If there was a faulty adjustment of the mechanism the radiograph would reveal it. In 4 is shown a radio transmission tube such as used by broadcasters. The upper half is glass and the lower half copper. The arrangement of grid and other hidden elements can easily be seen. Inspection by any other method would be impossible as it would mean dismantling the assembly.

Industrial Uses of X-Rays

Outside of medicine and surgery the field for utilizing X-rays is continually expanding. Especially is this true in industry, where they are used to inspect the internal quality of products. For instance, manufacturers of vacuum tubes examine the assembled tubes to determine if the delicate hidden parts are in correct position and the lead-in wires properly sealed. X-rays will reveal inner cracks, blowholes, cavities, and strains in castings, and are being used to improve foundry practise. Radiographic testing of castings for airplane and automobile motors is now general, not only for safety but to avoid machining and grinding a casting that would prove to be flawed at some later operation. Imperfect welds can be easily detected by X-rays. Radiographic tests are now employed to examine automobile tires for imperfect binding between the tread and the cords. X-rays will also show up foreign metallic bodies embedded in reclaimed rubber. Similar methods are used on other rubber products such as molded pieces, as well as on bakelite and condensite parts with metal inserts or internal seals, to examine them for faulty fabrication. In electrical apparatus, X-rays will show broken conductors inside insulated wires, and bring to light air bubbles or foreign metal bodies that might cause failure in operation at high voltages. In short, the X-rays provide the only means of definite inspection analysis short of actual destruction or actual use.

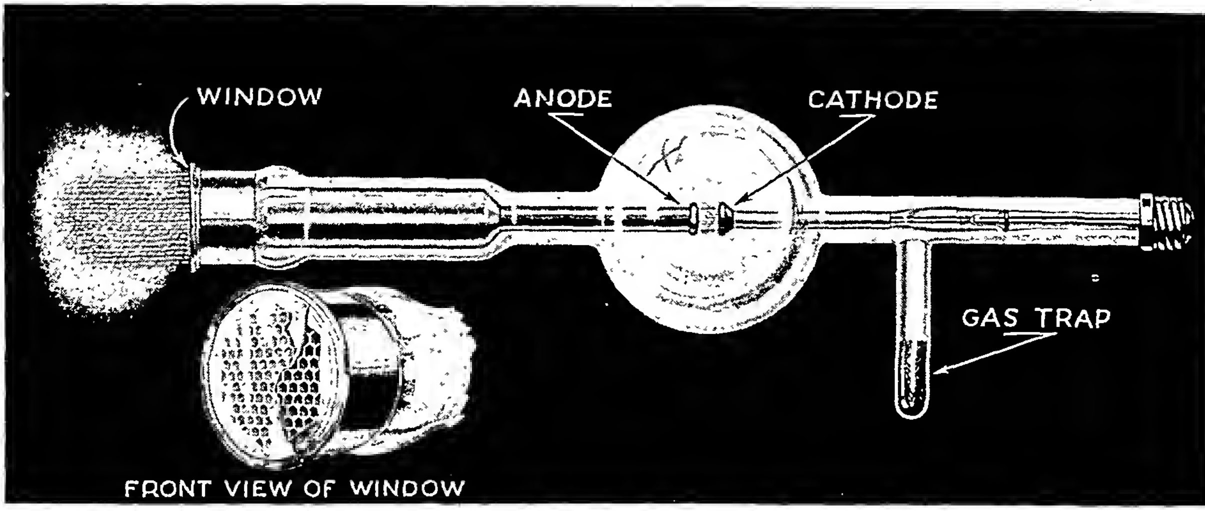
Coal is examined for percentage of slate and other impurities. In the field of art, the underlayers of old paintings can be inspected to determine authenticity, and detect possible retouching or alterations. Sculpture, inlays, and furniture offered to collectors and museums as antiques can often be classified by this method, and many frauds that formerly deceived the best experts have been uncovered. Police and customs inspectors use X-rays for searching out stolen or contraband articles concealed in baggage or in bales of innocent merchandise.

In the field of scientific knowledge X-rays have been of incalculable benefit. The shortness of the waves, which permits them to slip through between the atoms of substances, has been of far-reaching importance in discovering many things about these atoms—how they are arranged in molecules to form the various chemical compounds, and how the molecules in turn give shape to crystals.

Developing More Powerful X-Rays

Progress in the technique of using X-rays has been rapid. Early limitations of the power due to the relatively low voltage obtainable with the old-time induction, or Ruhmkorff, coil were overcome by development of modern transformers (*see* Electricity; Transformer) capable of stepping up current to enor-

BRINGING A STREAM OF ELECTRONS INTO THE OPEN



With this 350,000-volt cathode-ray tube William D. Coolidge succeeded in producing a stream of electrons in the air. The tube, developed in 1926, ushered in a new era of research and led to the development of the huge betatrons of today. In this vacuum tube electrons from a filament back of the cathode were thrown through the hollow anode by an electric field and out the window at the front. This was of foil, supported against outside air pressure by a honeycomb grating. The front of the tube was watercooled, and a charcoal-filled gas trap at the other end absorbed the products generated by the heat of the filament.

mous voltages. This permitted X-ray tubes to operate at potentials up to 2,000,000 volts. Early X-ray tubes had another important fault. Heavy bombardment of electrons from the cathode often caused the target to melt. William D. Coolidge of Schenectady, N. Y., solved this problem. He used huge anode targets made of tungsten, which has the highest melting point of all the metals. Coolidge tubes operated efficiently at voltages of 1,000,000 or more.

X-rays are produced whenever high-speed electrons strike a dense target such as gold or tungsten. To produce the "hardest," most deeply penetrating kinds of X-rays, electrons must be traveling at nearly the speed of light when they strike. Ordinary X-ray tubes cannot accomplish this, and so an *accelerator* is used in connection with an X-ray tube of special design. The accelerators most commonly used are the *Van de Graaff generator* and the *betatron* (*see* Atoms).

The Van de Graaff generator creates a powerful potential between the terminals of a vacuum tube. It thus accelerates electrons given off at the cathode into a beam that is as steady as the stream from a fire hose. One such machine used in research and materials-testing creates a potential of 2,000,000 volts. The tube used with this machine was developed by Raymond R. Machlett. It focuses the electrons into a narrow, concentrated beam much as an electron microscope does (*see* Electrons; Microscope).

The betatron, invented by Donald W. Kerst, accelerates electrons to vastly higher energies but does this in high-frequency bursts. Its beam is more like the fire of a machine gun than a jet of water. X-rays from betatrons of moderate size (from 4 to 25 million volts) are used in treating cancer. From this level betatrons range up to the largest betatron of more than 300 million volts. The deadly radiation produced by this machine is used only for research upon the nature of atoms. Its ultrahard rays can penetrate many inches of steel and shatter the nuclei of atoms, liberating neutrons and even mesons (*see* Atoms).

The production of high-energy beams of electrons in such devices as the Van de Graaff generator and the betatron has blurred the distinction once made between cathode rays and beta rays. Beta rays consist of fast electrons given off by radioactive substances. Cathode rays are normally slow-moving electrons. But scientists can now accelerate them so tremendously that they far surpass beta rays in energy.

'XYZ' AFFAIR. During part of the French Revolution, France was also at war with Great Britain. The French expected the United States to enter the war on their side, since the British were seizing American ships. In 1794, however, Britain and the United States settled their differences for the time being by a treaty. The French leaders in the governing body, the Directory, were bitterly angry. They declared that the United States had not kept its agreement with them, and they refused to receive the American minister, Charles C. Pinckney. They also began to seize American ships.

When John Adams became president, in 1797, he was anxious to avoid war, and he sent three agents—Elbridge Gerry, Pinckney, and John Marshall—to France to settle the difficulty. They were met finally by three French go-betweens, called X, Y, and Z in American dispatches. These men demanded a gift of $250,000 to Talleyrand, the French foreign minister, and a loan of $10,000,000 to France as a preliminary to negotiations. When the dispatches were published, they angered the United States to the point of starting a war. Then France gave in and the matter was settled by treaty in 1800. (*See also* Adams, John.)

During this affair Pinckney is said to have uttered the much-quoted phrase, "Millions for defense, but not one cent for tribute." Another version gives his reply as "No, no, not a sixpence."

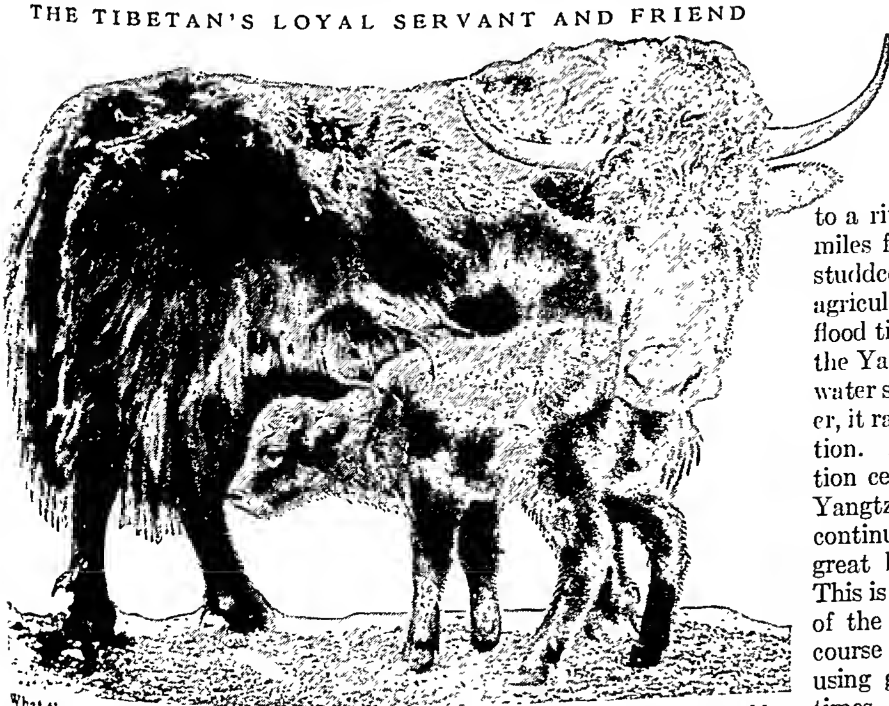
Y

YAK. No large animal habitually lives at greater heights than this member of the ox family, which is found in a wild state on the high plateaus of Tibet between the Altai and Himalaya Mountains.

It is about the height of a small ox and can at once be distinguished by the long hair which hangs from each side like a curtain, in some cases touching the ground. The color of the wild animal is black, but some of the domesticated breeds are black and white; and the hair is longer in the domesticated than in the wild forms. The tail also is very hairy, and the white tips are cut off by the Chinese, who dye them red and use them as tassels. In India they are used as fly snappers. There is a hump over the forelegs and this is exaggerated by the hairy mane.

The yak has been domesticated for centuries in Tibet and forms a great part of the natives' wealth. Its milk is rich and the curd is much used both fresh and dried; it makes excellent butter, which is preserved for a long time in bladders, and forms an important article of commerce. The flesh too is of fine quality and is often dried and eaten raw. The hair is spun into ropes and made into tent coverings, and the soft fur on hump and shoulders is woven into cloth. The skin with the hair on is used for caps, coats, and blankets. Domesticated yaks are used as beasts of burden and as draft animals, and work well in spite of scanty forage. Scientific name, *Bos grunniens*.

THE TIBETAN'S LOYAL SERVANT AND FRIEND



What the reindeer is to the Laplander, the yak is to the Tibetan native. It provides food and clothing, and it is the only beast of burden that can stand the high altitude of Tibet. The mother and youngster are as docile as they look in the picture.

YANGTZE (*yăng'tsĕ'*) **RIVER.** "Ta Kiang" (or Great River) is the name which the Chinese usually give to their longest and most important waterway, which ranks among the great streams of the world. "Yangtze Kiang" (*kiang* means river) as used by them refers only to the lower part, and the other portions have different names. From its source in the Kunlun Mountains of Tibet to its mouth in the East China Sea, this great river traverses the center of the country from east to west for a distance of some 3,000 miles, forming with its many connecting canals and rivers a highway of communication unparalleled in the world. Its basin of about 500,000 square miles includes the greater part of China proper.

The great cosmopolitan city of Shanghai, the commercial outlet for the whole of the basin, is situated 12 miles south of the mouth of the river. Here you may begin your trip up the river in a large ocean steamer, and will not have to change ships until you reach Hankow, an inland port that is nearly as far from Shanghai as Toledo is from New York. At its mouth the Yangtze River is 30 to 40 miles wide, and for a considerable time land is not visible. But finally you see the seaport of Chinkiang on the north bank, and after several days' journey through one of the most beautiful garden spots in the world, arrive at Hankow. The Hankow district is the commercial heart of China, and contains an amazing population (*see* Hankow). Every square yard on the shore seems to be the home of some family, and thousands of people spend their entire lives on the river in junks, houseboats, and "sampans."

Above Hankow the volume of water diminishes greatly, but by changing to a river steamer one may go 500 miles farther inland through a lake-studded country flanked with rich agricultural lands on either side. In flood times the lakes on the course of the Yangtze take much of its surplus water so that, unlike the Yellow River, it rarely causes death and destruction. Above Ichang steam navigation ceases, for here are the famous Yangtze gorges and rapids, which continue throughout most of the great bow-like trend to the south. This is by far the most beautiful part of the river, if we except its upper course in Tibet. The Chinese, by using great gangs of coolies, sometimes haul small boats 500 miles above Ichang.

YANKEE. Best known of all national nicknames, perhaps, is "Yankee." Yet the origin of this famous name for Americans is a mystery. Scholars once thought it came from *Yengees.* That was supposed to be the way the American Indians pronounced *English,* or its French equivalent, *Anglais.* Another theory is that a Dutch nickname *Yankey* is the source, because as early as 1683 it was used by Dutch sailors. *Yankey* may have been derived from *Janke,* a diminutive of the Dutch name *Jan* (John).

In America, in colonial times, the colonists of other sections rather scornfully called New Englanders "Yankees." The British did not observe the local distinction and used the term for all the colonists. During the Civil War southerners spoke of all northerners as Yankees. The British called United States soldiers "Yanks" in the first and second World Wars, and the term has gradually become popular as a nickname for all Americans.

The origin of 'Yankee Doodle' is also uncertain. This sprightly impudent tune had become popular in the colonies by 1770. The British used it to make fun of the Americans early in the Revolution, but the victorious Americans adopted it as their own marching song. The most famous verse runs:

Yankee Doodle came to town
Riding on a pony.
Stuck a feather in his hat
And called it Macaroni.

"Macaroni" was the name given to English dandies.

A 15-verse version called 'The Yankee's Return from Camp', begins:

Father and I went down to camp,
Along with Captain Gooding;
There we see the men and boys
As thick as hasty-pudding.
Chorus
Yankee doodle keep it up,
Yankee doodle dandy;
Mind the music and the step,
And with the girls be handy.

This version probably originated at the Provincial Camp, near Cambridge, Mass., in 1775 or 1776. In the slang of the day it tells a recruit's impressions of military life.

'Yankee Doodle' is now regarded as a national air. The authorship of its many verses is not known.

The YEAR—*Our* MEASURE *of* LIFE *and* HISTORY

YEAR. From remote times people have used two natural measures of time, the day and the year. The day—meaning the full period of 24 hours—measures one complete round of work, play, and sleep. The year, 365 or 366 days, measures one complete round of the seasons, from winter through spring, summer, fall, and back to winter again.

Early men did not need to measure the length of the day because the sun's rising or setting did this for them. But they did need some way of measuring the length of the year. This was especially true if they lived in regions where the winters were cold. They had to know in good time when to prepare for the hard months ahead if they were to live through them.

Each year they got some warning. They could feel the nights getting colder and see the leaves changing color. But this warning was vague and often deceptive. An autumn might be long and mild, and then severe cold might come with a rush. A better check on the passage of the seasons was needed.

At some early time, men discovered a workable method. They realized that full moon followed full moon in a regular and endless procession. Twelve "moons" corresponded well enough for their purposes to a complete cycle of seasons, from winter back to winter again. By keeping a record of full moons, men could know when to expect the killing frosts of winter.

For thousands of years men had no better way to keep track of the seasons. Many primitive people today use the *moon* (meaning month) as their longest unit of time. Until the American Indians learned the white men's ways, they counted time by moons. (For picture of the Kiowa calendar, *see* Indians.)

Eventually some ancient people, probably the Sumerians of Babylonia, worked out a real calendar based on the moon. The ancient Greeks and the Romans until the time of Julius Caesar used similar lunar calendars. Even today the Jews and Mohammedans use lunar calendars in their religious observances, and the Christian Easter is fixed by rules derived from them.

All such calendars were cumbersome and complicated, however, because 12 cycles from full moon to full moon do not amount to a full year. To be correct, the year must measure one cycle of seasons exactly; and the seasons are caused by the relative positions of the earth and the sun in space (*see* Astronomy; Seasons). Therefore the year is the time from an instant when the earth and the sun are in some particular relation to each other until the instant when they are in the same relation again.

Today we know that this time amounts to about 365¼ days. But the moon goes through its phases 12 times in about 354 days—11 days less than a full year. Complicated corrections were needed in all lunar calendars to allow for this.

Measuring the Year by the Sun

Perhaps the priests of ancient Egypt were the first to devise a reasonably accurate calendar. They needed a good measure in order to foretell the annual flooding of the Nile. Sometime about 30 centuries B.C. they fixed the length of the year as 365 days. They may have done this by averaging the lengths of time between floods. Another theory credits them with accurate observations of the sun.

Another ancient method used the seasonal shift of the noon sun from low to high in the southern sky (*see* Astronomy; Equinox and Solstice). The day when it stood highest was (and still is) the day of the summer solstice. Stonehenge in England is probably an ancient pagan temple built for observing the solstices.

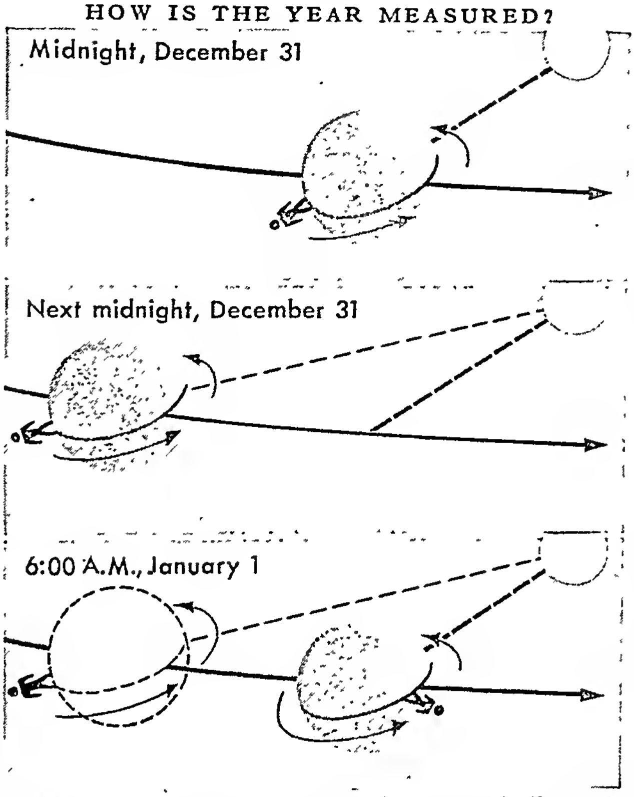
All ancient astronomers, whatever method they used, eventually made an important discovery about the year. After keeping records for many years, they found that the year was not *exactly* 365 days long. Instead it was about 365¼ days in length.

The Problem of the Calendar

From ancient times to the present, men have been concerned with fitting this odd period of time into a calendar year of whole days. For the civil (calendar) year should complete itself at the end of a particular day, and the next year should begin at the start of the next day.

It is easy to see what would result if we used 365¼ days as the calendar year. Suppose that this current year ended at midnight of December 31. Then suppose that 365 days passed. Everyone would then be ready to celebrate the beginning of the next year. But the next year would not begin until another quarter day (six hours) had passed. This would be at six o'clock on the morning of January 1. The following year would begin at noon of January 1, the next year at six in the evening, and the next at midnight again. But this last year would start on January 2, instead of January 1, as it should.

HOW IS THE YEAR MEASURED?



A year is the time taken by the earth to return to the same point on its orbit. In the top picture a heavy broken line marks this starting point. After exactly 365 rotations (middle), the earth has not quite returned to this point. It must rotate for another quarter day while moving forward on its orbit before the "true" (or natural) year is completed (bottom picture).

Eventually, of course, New Year's Day would run through all the seasons, unless some correction were made. In 46 B.C. Julius Caesar solved this problem by establishing a *common year* of 365 days and a *leap year* of 366 days every fourth year. This method ignored the quarter-day error until it had accumulated for four years. Then a full extra day was inserted in the calendar. The Romans gave the extra day in leap year to February because that month was once the last month of their calendar. We still follow the Roman practise, although our year begins two months earlier.

After many years, men realized that the year was not exactly equal to 365¼ days either. It is actually about 11 minutes shorter. In some 1600 years after Caesar's reform, these 11 minutes had added up to 13 days, and Pope Gregory XIII corrected the calendar again. The Julian calendar had had 13 leap years too many. So Gregory provided for omitting the extra day in three out of four century years—that is, years ending in 00. Only the century years which are divisible by 400 are counted as leap years. Under this rule, 1700, 1800, and 1900 were not leap years, but 2000 will be. This rule was put into effect for Roman Catholic countries in 1582 (*see* Calendar). The rule is still not quite accurate, and our descendants in the year 4000 will have to drop another day.

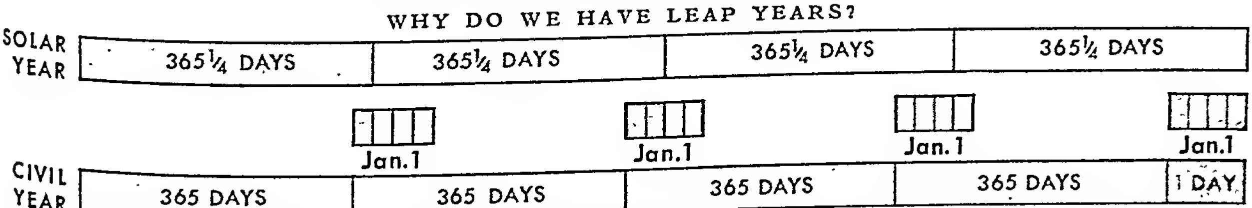
Three Kinds of Year

A true year (not a calendar year) may be defined as the time the earth takes to return to the same point on its orbit. But there are several ways of defining "the same point." So astronomers recognize several sorts of year.

The simplest reference point to use is a point on the orbit where the earth lines up with the sun and some particular star. Such a point is fixed; it remains in the same place century after century. The year measured between two successive crossings of such a point is called the *sidereal* year (from Latin *sidera*, "star"). It is 365 days, 6 hours, 9 minutes, 9.5 seconds long.

Another reference point used by astronomers is a point on the orbit where the earth's axis is perpendicular to a line from the sun. Twice a year, in spring and fall, the earth stands in such a position. A year measured between successive crossings of one of these points is called the *tropical* year. It is equal to 365 days, 5 hours, 48 minutes, and 46.0 seconds.

WHY DO WE HAVE LEAP YEARS?



A calendar using the solar year of 365¼ days would be undesirable. So the common civil year is fixed as 365 days—midnight of December 31 to midnight of the next December 31. The difference of one quarter day a year mounts up until it equals one full day. Every fourth year (leap year), this extra day is added to the calendar. Then the calendar and the solar year are again in step.

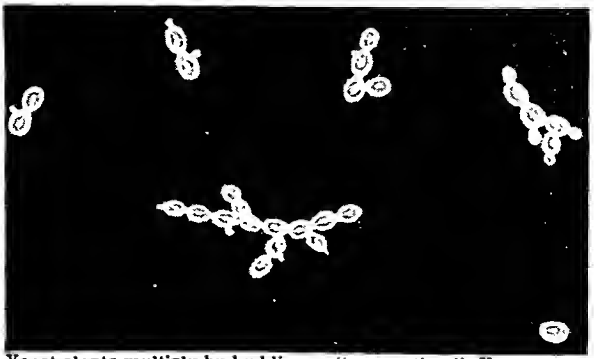
The tropical year is about 20 minutes shorter than the sidereal year because of a slow, wobbling movement of the earth's axis. This movement, called *precession of the equinoxes,* is explained in the article Astronomy. The seasons keep in step with the tropical year because both are based on the position of the earth's axis (*see* Seasons; Astronomy). For that reason our calendar year is based on the tropical year.

Still another reference point is the *perihelion* (the point on its orbit at which the earth is closest to the sun). Two successive crossings of this point give the *anomalistic* year. The perihelion is moving slowly in the same direction the earth travels on its orbit. So the anomalistic year is longer than either the sidereal or tropical year. Its exact length is 365 days, 6 hours, 13 minutes, and 53.0 seconds. The anomalistic year is very little used.

YEAST. Among the smallest of all living things are the one-celled fungi called yeasts. They are tiny plants invisible except to the eye of the microscope. Like all plants and animals, they need oxygen to live and grow. But yeast plants do not have to get their oxygen from the air. Their bodies contain substances called *enzymes.* These enable the yeast plants to extract oxygen from almost any substance that contains sugar. When they do this, they bring about certain chemical changes called *fermentation* (*see* Enzymes; Fermentation).

The kind of fermentation that is carried on by the activities of yeast plants produces, among other things, alcohol and the gas carbon dioxide. These are of no use to the yeast plants. They are merely by-products in getting oxygen. But from man's point of view they are of great importance. We use yeasts in the manufacture of wine, beer, liquors, and most of the raw alcohol employed in science and industry (*see* Alcohol). We use them also in breadmaking. Here the carbon dioxide is the important factor. The yeast plants are buried inside the dough and immediately begin to work on the sugars contained in the flour. The bubbles of gas they give off as they breathe raise, or *leaven,* the dough, making the little round holes we see in bread after it is baked. The alcohol produced in the dough evaporates. (*See* Bread and Baking.)

WATCHING THE YEAST PLANTS MULTIPLY



Yeast plants multiply by budding or "gemmation." You can see some of the tiny buds forming in this highly magnified picture. As the cells bud and grow, they form branching clusters, or colonies, which later break up to form new colonies.

How the Yeast Cells Grow

Under favorable conditions yeast plants grow and multiply with tremendous speed. As soon as a cell reaches full size, it puts out a bud. When this becomes a full-grown cell it puts out another bud. Thus chains and clusters of the tiny one-celled plants develop. These are known as *colonies.* They break apart from time to time and start new colonies. Under certain conditions the yeast plant forms spores within its cell. Thus the cell becomes an *ascus,* or spore case. It usually contains one to four spores. The cell wall disintegrates, and the spores, like tiny particles of dust, travel here and there in the wind or on bodies of insects and other animals.

Scientists used to think that reproduction of common bakers' yeast by spores, like that by budding, was asexual. In 1943 Carl C. and Gertrude Lindegren, working at the Henry Shaw School of Botany, Washington University, St. Louis, demonstrated that the spores are of two mating types. Some produce "male" *gametes,* or sex cells, and some produce "female" gametes. If a yeast spore germinates away from other spores, its gametes, though of the same sex, occasionally unite by pairs to form new yeast plants. But these plants do not usually produce living spores. If, however, several spores germinate together, releasing gametes of both types, opposite types tend to unite to form new plants. These plants are capable of producing living spores.

If any moist substance containing sugar is left open to the air, yeast spores are almost sure to fall into it and start fermentation. But certain kinds of yeast may create, along with alcohol and carbon dioxide, other substances with unpleasant flavors and odors. For this and other reasons, bakers, brewers, and wine makers do not rely upon the wild yeasts. A half-dozen of the most desirable species have been obtained in pure standard cultures and are regularly grown for use in the fermentation industries. The discovery that yeast spores are of two mating types opened up new possibilities for improving yeast strains By cross-breeding, the botanist can combine useful characteristics of different strains.

How We Get Our Yeasts

Various processes are used in the growing and manufacture of yeast, but all are based on the same principles. The tiny yeast cells must be provided with nourishment and with plenty of air, and the temperature must be carefully controlled.

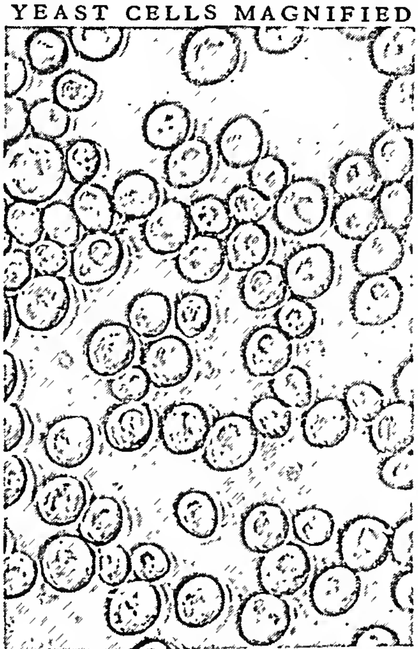
The proper foods for yeast plants are corn, barley, malt, and rye. The grains are cleaned, ground in mills, and then "mashed" (mixed with filtered water) The corn must also be "cooked" before it is mixed with the other ground grains. Malt or sprouted barley is then added to the mash in order to convert the starch of the corn and rye into malt sugar. Malt sugar is the food on which yeast plants thrive best.

The next step in the process is the addition of a pure culture of lactic acid bacteria. These are the bacteria which cause the souring of milk. They make the

grains still more digestible for the little yeast plants, and also insure a healthy fermentation. This action takes place in the "souring tank."

The mash is now ready to be filtered; the clear filtered extract is called the "wort." After being cooled, the wort is piped into huge copper tanks. Here living yeast plants from a former batch are added to start the growth of a pure culture, and the proper conditions for fermentation are supplied. The little yeast plants grow very rapidly, as they do later in the making of bread. After about 12 hours, a great mass of yeast substance has been produced from the wort.

YEAST CELLS MAGNIFIED



These cells are magnified 1,000 times. You can understand how small the cells really are when you learn that a single cake of yeast contains millions of them. If the cake is kept at the right temperature and humidity, the cells stay alive indefinitely.

The same yeast plants behave differently under different methods of fermentation. When fermentation takes place in a low temperature, the yeast forms soft masses at the bottom of the liquid and is called *bottom yeast*. In a high temperature the liquid bubbles vigorously and carries the yeast to the surface, forming *top yeast*. The squares that we know as compressed yeast are made by filtering out top yeast with a fine sieve and pressing it to squeeze out the water.

Yeast, especially brewer's yeast, is rich in the minerals needed in food, and in proteins, carbohydrates, and vitamin B (*see* Vitamins). It is used to enrich food both for human beings and for animals, and also as a concentrated food substitute.

Yeasts belong to the order *Saccharomycetales*, of the class called sac fungi (*Ascomycetes*). The two important enzymes secreted by the yeasts of commerce are *invertase* and *zymase*. The first of these changes other sugars into *glucose* and *fructose*. These are then converted by the zymase into alcohol and carbon dioxide. (*See also* Fungi.)

YELLOWSTONE NATIONAL PARK. Violently erupting geysers, boiling caldrons of water and mud, and vividly colored terraces give this great park a strange and unforgettable beauty. Yellowstone is the oldest, the largest, and the most famous national park in the United States. Its area is 3,458 square miles, more than two and one-half times that of Rhode Island. Most of the park lies in the northwestern corner of Wyoming, but it extends slightly into Montana and Idaho.

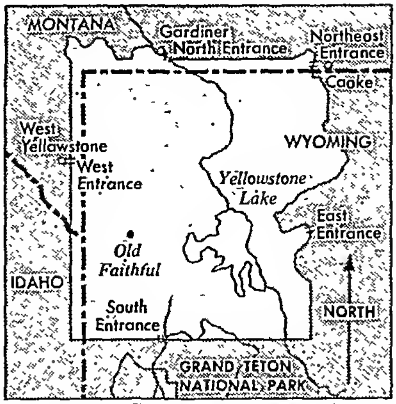
The park is situated in the heart of the Rocky Mountains. Its central portion is a high, rugged tableland which reaches an altitude of 7,000 to 8,000 feet. Lofty mountains, rising to 10,000 and 11,000 feet above sea level, surround the plateau on the north, northwest, south, and east. The Continental Divide crosses the southwest corner of the park.

Almost the entire region is volcanic, and both mountain and plain are formed from ash, lava, and other substances thrown up out of the earth. The numerous geysers and hot springs show that volcanic forces are still at work (*see* Geyser). The most famous geyser is Old Faithful. It has thrown its plume of boiling water into the air at a remarkably regular interval of about 65 minutes since it was first seen by white men. Old Faithful is only one of about 20 geysers in the Upper Geyser Basin. One of its companions is the tremendous Giant Geyser. It spouts a column of water 200 to 250 feet into the air for an hour at a time every week or two. Besides this great blowing, steaming area, there are four other geyser basins within the park.

A RAINBOW IN STONE—HYMEN TERRACE IN YELLOWSTONE PARK

At Mammoth Hot Springs, in the north of the park, the lime-laden waters have built up terrace on terrace of marblelike rock, tinted with pink, red, blue, and yellow by the algae found in the water. Nowhere else in the world are such formations known to exist.

WHERE YELLOWSTONE PARK IS



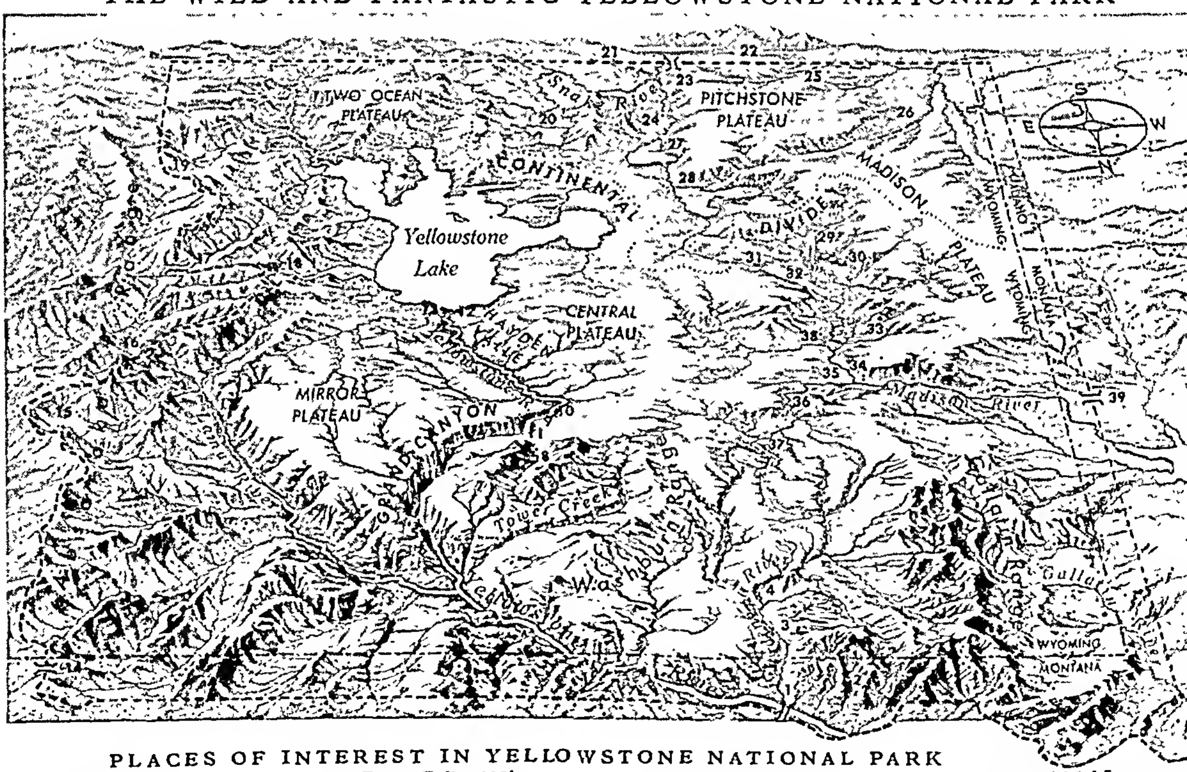
Yellowstone National Park lies in the northwestern corner of Wyoming, extending a little into Montana and Idaho. Grand Teton National Park is only a few miles south of its south boundary. This map shows north at the top; but the picture diagram below is reversed and has south at the top in order to show the natural features more effectively.

Almost as striking as the geysers are the hot springs and pools. Visitors always see the Mammoth Hot Springs with their terraces colored red, blue, and brown by algae. The Morning Glory Pool is also world famous. It is deep and trumpet-shaped, and its stony sides are colored a vivid luminous blue. Besides the hot-water pools, there are strange pools of mud and clay which boil violently. In some places steam constantly issues from holes called *fumaroles*.

The volcanic phenomena are only a part of the scenic wonders of the park. In its heart is Yellowstone Lake, one of the most beautiful mountain lakes in the world. From the lake, the Yellowstone River flows north to plunge over two great falls into the many-colored Grand Canyon of the Yellowstone. (This is not to be confused with the larger Grand Canyon of the Colorado.) The 1,200-foot walls of this magnificent valley are of a yellow volcanic stone called *rhyolite*. Oxidation has tinted the stone with shades of red, pink, purple, orange, and brown. (For illustration in color, *see* National Parks and Monuments.) Except where roads, trails, or camps have necessitated cutting, the primeval forest still stands untouched by the woodsman's ax. The trees are chiefly evergreens. The most common are lodgepole pine, Douglas fir, and spruce. The park also has petrified forests, though most of these trees are in inaccessible areas.

This great scenic park is one of the greatest wildlife sanctuaries in the world. Even a casual visitor may see grizzly bear, black bear, bison, and many species of birds. Those who take to the trails on horseback may also see deer, antelope, elk, moose, and the shy bighorn, or Rocky Mountain sheep. The streams and rivers abound in trout. Fishing is permitted without a license, but all hunting is prohib-

THE WILD AND FANTASTIC YELLOWSTONE NATIONAL PARK



PLACES OF INTEREST IN YELLOWSTONE NATIONAL PARK

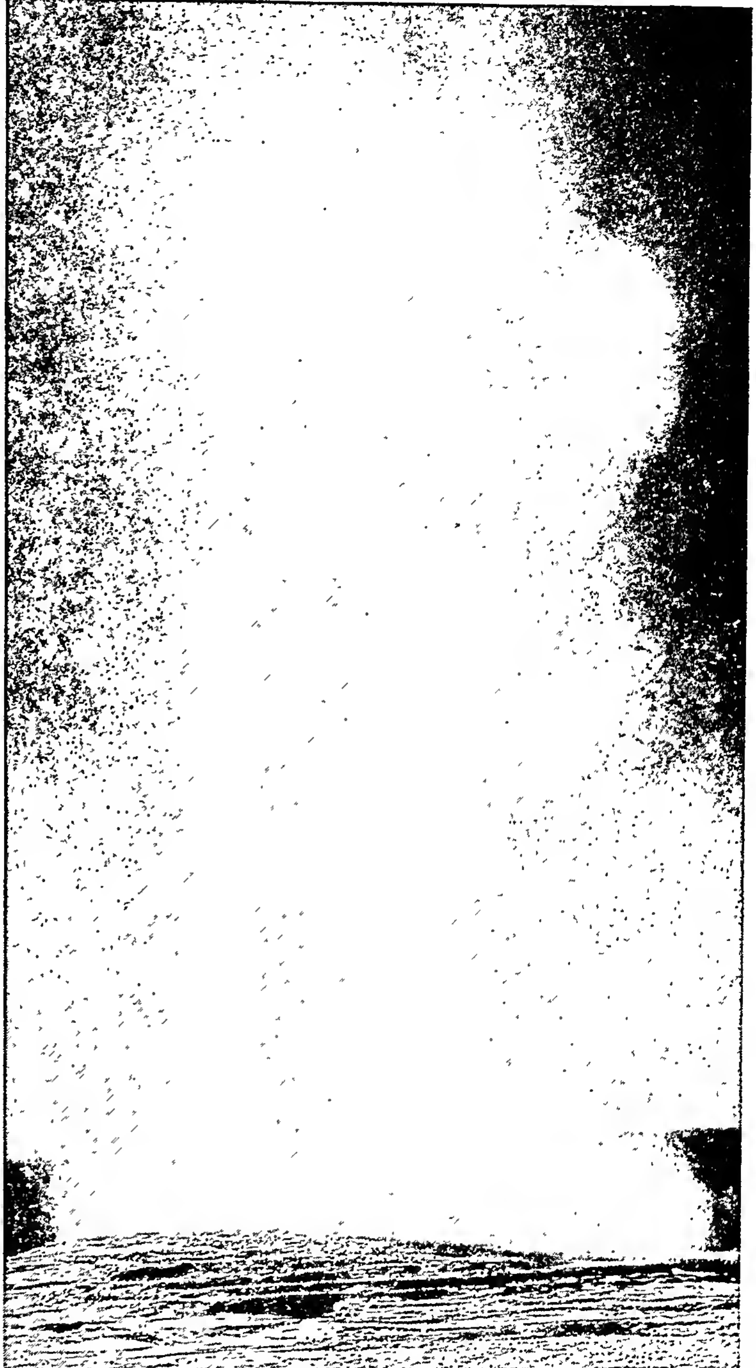
1. North Entrance (Gardiner)
2. Electric Peak, 11,155′
3. Mammoth Hot Springs
4. Bunsen Peak, 8,600′
5. Tower Falls, 132′
6. Basaltic Cliffs
7. Mt. Washburn, 10,346′
8. Dunraven Pass, 8,859′
9. Canyon Lodge and Hotel
10. Upper Falls, 109′
11. Lower Falls, 308′
12. Lake Lodge and Hotel
13. Fishing Bridge
14. Northeast Entrance (Cooke)
15. Hoodoo Peak, 10,522′
16. Notch Peak, 11,006′
17. East Entrance (Cody)
18. Sylvan Pass, 8,557′
19. Eagle Peak, 11,360′
20. Heart Lake
21. Jackson Lake
22. Teton Mountains
23. South Entrance (Snake River)
24. Lewis River
25. Falls River
26. Bechler River
27. Lewis Lake
28. Shoshone Lake
29. Old Faithful Geyser
30. Old Faithful Inn
31. Craig Pass, 8,262′
32. Upper Geyser Basin
33. Lower Geyser Basin
34. Firehole River
35. Cascades of Firehole
36. Gibbon River
37. Norris Geyser Basin
38. Fountain Paintpot
39. West Entrance (West Yellowstone)

ited. Black bears have learned that tourists are generous with gifts of food. One of the sights of Yellowstone are these beggars and their cubs along the highways. Tourists are warned never to feed the park animals; many who disregard the warning are injured each year.

Roads and trails allow visitors to enjoy the deep, cool forests and remote fishing grounds, as well as the more spectacular features of the park. Large hotels, lodges, and campsites provide accommodations. Visitors may drive their own automobiles through the park or they may take conducted bus tours.

The Yellowstone region was set aside as a national park in 1872, under the Department of the Interior. The National Park Service, through a superintendent and a force of park rangers, administers and protects this vast wonderland. The park season lasts from late in June to about the middle of September; but limited facilities are usually available from late spring until snow closes the roads in midautumn.

OLD FAITHFUL—KING OF THE GEYSERS



Most famous of the Yellowstone Park geysers is Old Faithful. It gets its name from the fact that its eruptions are frequent and fairly regular. Old Faithful erupts usually after an interval of about 65 minutes, though the time varies from 38 to 81 minutes. It sends a jet of boiling water to a height of from 120 to 170 feet. The cone is built up of the minerals that are deposited by the water as it cools.

YEW. In the days of Robin Hood, before gunpowder had taken the place of bows and arrows, the strong and elastic wood of the yew tree was in great demand in England for the making of bows. Yews were planted in nearly every churchyard in England to protect the churches from high winds with their sturdy growth. It also became customary to clip the yew trees into smooth compact cones or pyramids of green or into complicated geometrical shapes. Some were even cut to look like grotesque beasts and birds.

The yew is a very slow-growing tree. It is a century or more old before it is large enough for cutting. It is also a very long-lived tree. Some of the oldest specimens in England are more than ten feet in diameter and are estimated to be over 1,200 years old. Yew wood is highly valued for cabinetmaking because of its close grain, its reddish color, and its hardness. It takes a smooth and beautiful polish.

Yews belong to the genus *Taxus* of the yew family (*Taxaceae*). They are small trees or shrubs, found throughout the Northern Hemisphere. The English yew (*Taxus baccata*) is cultivated in North America as far north as New York. The trunk is short and thick, with bark that has deep fissures when the tree becomes old. It may grow 60 feet high. The Pacific, or western, yew (*Taxus brevifolia*) grows from 20 to 40 feet high. It grows very slowly and reaches maturity in about 250 to 350 years. It is found from Alaska to California and east to Idaho and Montana, and from sea level to 8,000 feet. At the timber line it is a dwarfed, often sprawling shrub.

Chinese and Japanese yews will grow to 50 feet, but in North America they are commonly grown as small ornamental trees. The ground hemlock (*Taxus canadensis*) is a straggling, low-growing shrub found in northeastern United States and Canada as far north as Newfoundland.

All yews have a naked seed surrounded by a fleshy cup which looks like an open berry. The leaves are flat, ½ to 1¾ inches long and pale on the under-

THE COMMON ENGLISH YEW

This yew branch is heavily laden with its bright scarlet, cup-like fruit. The foliage of the English yew is poisonous, especially to horses and cattle, but the leaves were once used as a medicine for human beings.

side. They are poisonous to livestock. Small, solitary flowers appear early in the spring.

YOKOHA′MA, JAPAN. When Com. Matthew C. Perry and Japanese officials signed the treaty opening Japan to world trade, in Yokohama, in 1854, the town was a tiny fishing village of thatched huts. Its steady growth began five years later when it was opened to foreigners as a treaty port. It is now Japan's fifth city and second port. Its wide streets, well-constructed buildings, and modern port facilities give little evidence that it has been nearly destroyed twice, by earthquake in 1923 and by bombing in 1945 during World War II.

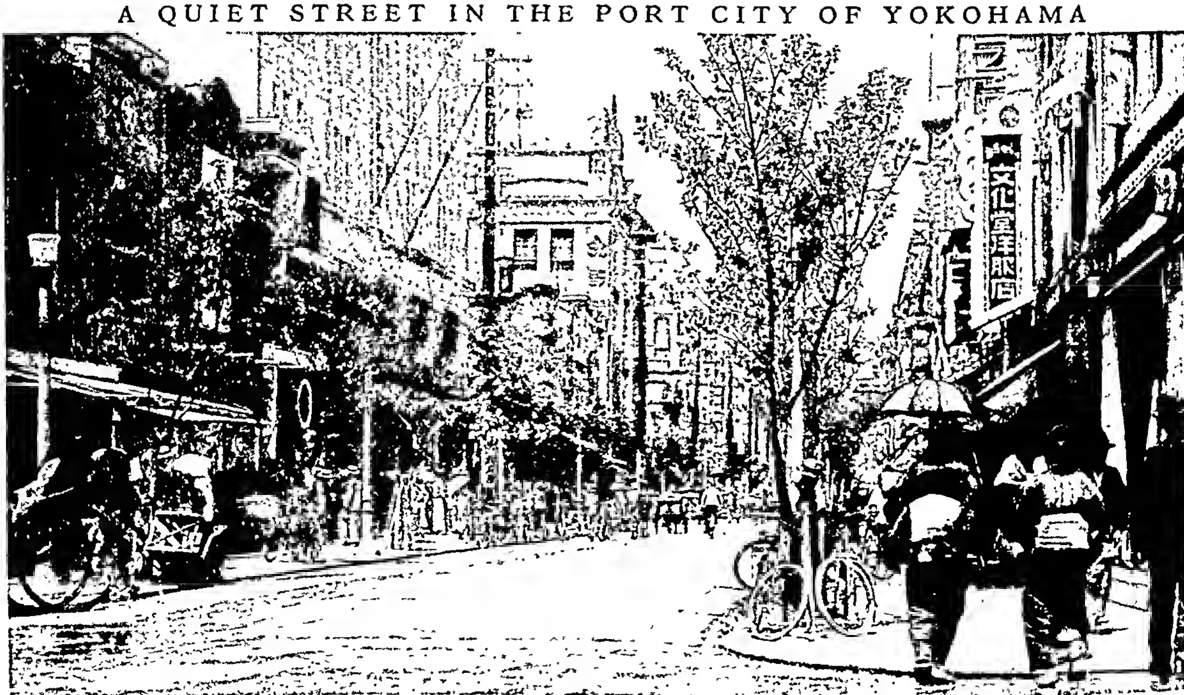
Yokohama's location on a deep harbor on the west side of Tokyo Bay, only 18 miles southwest of Tokyo, made it the natural port of the capital. It handles vessels too large for Tokyo's shallow harbor. The two harbors function as one (called Keihin), and suburbs link the cities. The surrounding Kwanto plain and nearby hills produce most of Japan's silk, so Yokohama is the largest silk-shipping port. Rayon goods and canned fish are other large exports.

The swift streams cascading from the hills have been harnessed to provide power for manufacturing. Engineers reclaimed land from the bay to provide level sites for many factories. The chief industries include machinery, electrical equipment, chemicals, metals, automobiles, oil refining, shipbuilding, silk weaving, printing, and food processing.

Money largely from the United States paid for the first harbor improvements that made Yokohama a great modern port. In 1863 a Japanese feudal lord had fired on American vessels in Shimonoseki Straits, and the United States had received from Japan an indemnity of $800,000. Some time later the United States returned the indemnity, and in 1896 Japan used it to develop Yokohama's harbor and to build a vast breakwater as a monument to American good will.

In 1923 virtually all the city was destroyed by an earthquake. The earthquake struck at noon when charcoal stoves were lighted for luncheon. Flames from the crumpled buildings engulfed the city. When the Japanese rebuilt it, they laid out wide avenues as firebreaks and constructed many fireproof build-

A QUIET STREET IN THE PORT CITY OF YOKOHAMA



Yokohama is a sprawling port and manufacturing center on Japan's Tokyo Bay. The city, however, has many quiet tree-lined business streets, such as this one, away from the bustle of the harbor facilities and factories.

ings. The working people, however, again put up cheap homes made of wood and paper.

During World War II Yokohama boomed with war industries. In 1945 American bombers, based on carriers or on conquered islands, repeatedly blasted the city, causing 44 per cent destruction. Population (1950 census), 951,189.

YONKERS, N. Y. An advantageous site on the Hudson River just north of New York City has brought prosperity to Yonkers. Industries also got an early start with water power from the swift little Nepperhan River, which emptied into the Hudson at Yonkers. Among them were sawmills and gristmills and an iron furnace. After electric power became available, the river dams were destroyed and the Nepperhan became a mere trickle.

At first the city's products were carried to New York City's markets by water. Later a main-line railroad and highways carried its products throughout the nation. The chief modern manufactures are carpets and rugs, elevators, clothing, chemicals, wire and cable, and iron and steel articles.

Yonkers occupies a five-mile stretch of hollows and terraces on the Hudson's east bank, across from the New Jersey Palisades. Its eastern boundary is the Bronx River and its southern reach touches the northern boundary of New York City. The larger factories cling to river-front locations.

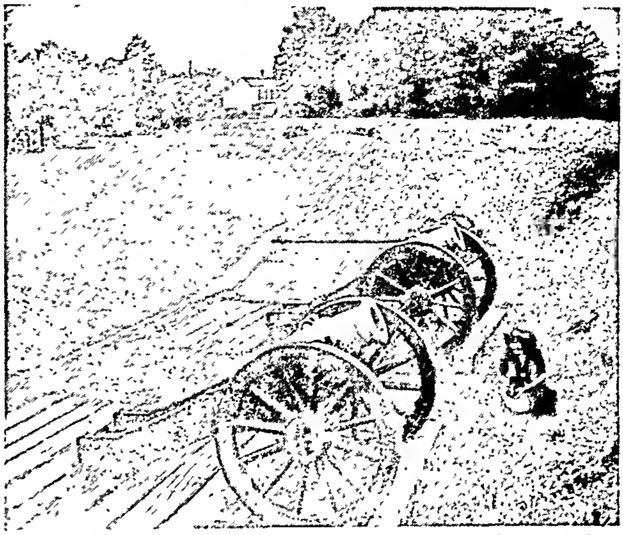
The Dutch West Indies Company purchased the area from the Indians in 1639. In 1646 Adriaen Van der Donck built a sawmill at the junction of the Nepperhan and Hudson. Van der Donck was called *DeJonkheer*, or "the young nobleman," by the people he brought to colonize the land. Later this was shortened and Anglicized to "Yonkers." When the British took possession of New York in 1664, Frederick Philipse acquired title to the area. Philipse Manor, now a state-supported museum, has a valuable collection of portraits of the nation's presidents. During the Revolution, American authorities confiscated the estate because the Philipse descendants sided with the British.

Yonkers is the seat of the Roman Catholic St. Joseph's Seminary and College. The city's Hudson River Museum contains much material dealing with the river's history. The Boyce Thompson Institute of Plant Research also is here.

The town of Yonkers was founded in 1788. It was incorporated as a village in 1855, with a population of more than 7,000. It was chartered a city in 1872. It has the council-manager form of government. Population (1950 census), 152,798.

YORKTOWN, VA. This famous tidewater village has twice figured prominently in American history—in 1781 and 1862. George Washington, commander of the allied French and American forces, captured Lord Cornwallis' army and accepted his surrender there. The British surrender virtually closed the Revolutionary War. In the Civil War the Union commander, General McClellan, besieged Yorktown for a month and so delayed his Peninsular Campaign that it failed. The battlefield of 1781 is in Colonial National Historical Park, which includes Jamestown, Colonial Parkway joining Yorktown and Williamsburg, and Cape Henry Memorial. The fortifications and several 18th-century houses have been preserved. A monument recalls Cornwallis' surrender. Yorktown is the county seat of York County, Va. Population (1950 census), 384.

FORTIFICATIONS OF YORKTOWN



Little Yorktown, Va., was the scene of the last big campaign of the Revolutionary War. The earthworks shown here were dug by soldiers of the Allied French army. The fortifications are in Colonial National Historical Park.

YOSEMITE (*yō-sĕm'ĭ-tē*) **NATIONAL PARK.** So magnificent is Yosemite Valley in central California that it has been made part of Yosemite National Park. Located 200 miles east of San Francisco, it is

WILDLIFE IN YOSEMITE

The wild animal life and breath-taking beauty of Yosemite Falls captivate all who visit the famous park.

YOSEMITE'S MAJESTY FROM THE AIR

Some of the West's finest scenery is in the Yosemite Valley. The valley is dominated by the great bulk of Half Dome (1). Nearby are Ribbon Fall (2) and the Nevada and Vernal falls (3).

Farther down the valley, Yosemite Falls (4) thunder opposite scenic Glacier Point (5). Across from the cliff El Capitan (6), filmy Bridalveil Fall (7) drops from Cathedral Rocks (8).

about seven miles long and one mile wide. Travelers declare that its beauties are unsurpassed anywhere.

The Yosemite Valley is a splendid example of glacial erosion on a grand scale. During the Ice Age, great glaciers moved down the narrow V-shaped valley of the Merced River, widening and deepening it. In some places they carved away 1,800 feet of solid granite to form the vast U-shaped canyon as it now exists. When the last glacier retreated, it left the valley floor covered by a large lake, dammed at its lower end by a glacial moraine. The moraine was cut through by the flowing stream, however, and most of the lake drained away. What remained was silted up until now the valley floor is meadowland.

By deepening the valley, the glaciers also left several tributary valleys hanging high above the main valley floor. From these now drop the many spectacular falls of the Yosemite Valley. Near the upper end of the valley the Merced River plunges down in two stages. The first forms the Nevada Fall, 594 feet high, and the second the Vernal Fall, 317 feet. The greatest falls, however, are on the north wall of the canyon. There the narrow Ribbon Fall drops 1,612 feet; it is the highest waterfall in North America. On the same wall are the Upper and Lower Yosemite Falls. Yosemite Creek drops sheer for 1,430 feet, cascades down in rapids another 675 feet, and then plunges to the valley floor in a final leap of 320 feet. From the south rim of the canyon drops the gauzy Bridalveil Fall, 620 feet high, and farther up the valley is the Illilouette Fall, 370 feet. (For illustration in color, *see* National Parks.)

As spectacular as the falls of Yosemite are the majestic cliffs and peaks that tower over the valley. Highest of these is Half Dome, a mass of rock which juts up 4,892 feet from the meadows at its feet. Near the Bridalveil Fall are the impressive Cathedral Rocks and across the valley is the overpowering monolith El Capitan, 3,604 feet high. Visitors view the panorama of the valley from the lookout on Glacier Point. From here can be seen many of the falls and peaks. To the east is Half Dome and beyond it is the beautiful peak called Clouds Rest. To the west is the great Sentinel Rock.

In Yosemite National Park are three groves of colossal sequoias, the Mariposa, the Merced, and the

Tuolumne (*twŏl'ŭm-nē*). Among the trees in the Mariposa Grove is the Grizzly Giant, thought to be at least 3,800 years old (*see* Sequoia). The park also has a large tract of the giant sugar pine, a tree found only in California and Oregon. Within the park is the Hetch Hetchy Valley, which has been converted into a reservoir for San Francisco's water supply.

Hotels and campsites in the park provide accommodations for visitors. Tourists may fish, hike, or ride horseback while enjoying the unparalleled scenery. The National Park Service conducts free week-long hiking trips over the high Sierra trails north and east of the valley. In the winter skiing may be enjoyed at Badger Pass and other points around the valley.

YOUNG, BRIGHAM (1801–1877). The founder of Utah and patriarch of the Mormon church, Brigham Young, was born June 1, 1801, in Whitingham, Vt., the ninth of 11 children. His father, who had been a soldier in the Revolutionary War, was a pious man and an unsuccessful farmer. The family resettled many times and Brigham grew up in western New York State. He cut wood and plowed as other farm boys did, and there was little time for school or amusements. Brigham Young later said that he had gone to school no more than 11½ days. He became a painter and glazier, and at 23, when he could support a wife, he married Miriam Angeline Works.

Western New York was known in those days as the "burnt-over district" because of the many fiery religious revivals that swept across it. As a boy and young man, Young was deeply disturbed about religion and tried earnestly to find some one true faith. Then in 1830 a copy of the 'Book of Mormon' came into his hands. Joseph Smith had just printed the book and founded his Church of Jesus Christ of Latter-day Saints (the Mormon church) at Fayette, N. Y. (*see* Mormons). Young studied the book for two years and in 1832 was baptized by a brother of Joseph Smith.

He immediately became an effective Mormon missionary. In 1833 he led a group of Mormons to Kirtland, Ohio, and two years later was appointed to the Quorum of Twelve Apostles. He became Smith's most trusted lieutenant, and when the Mormon settlement in Jackson County, Mo., was forced to leave in 1838 he led the migration to Illinois. There he assisted the Prophet in establishing Nauvoo.

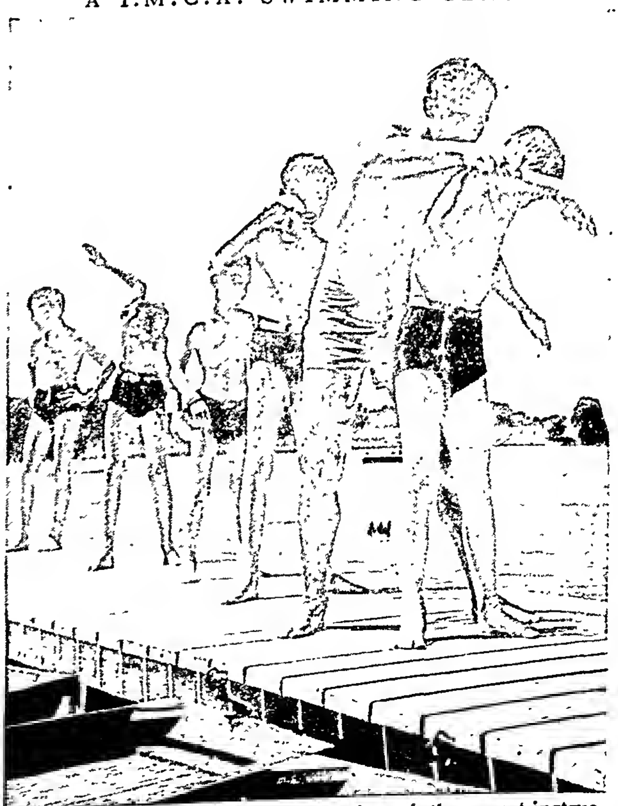
After Smith's murder in 1844, Brigham Young became president of the church. By 1847 it had become impossible for the Mormons to live in peace among the "gentiles," as they termed non-Mormons, and Young led the first migration to the Far West. With courage and farsightedness he selected the forbidding Salt Lake Valley as the new Mormon home. "This is the place," he said upon seeing it. With practical sense he forbade mining the region's mineral wealth until irrigation had brought the rich land under cultivation. He planned and built Salt Lake City as the "new Jerusalem" of the Latter-day Saints. This beautiful city remains Brigham Young's most effective monument (*see* Utah; Salt Lake City).

For 30 years more he personally directed the affairs of the Mormon church. When Utah became a territory of the United States in 1851, he was appointed governor. A shrewd businessman, he profited from a contract to build a section of the Union Pacific Railway and he also built and operated connecting roads within the territory. The territory's telegraph system was his as well. His greatest commercial success, however, was Zion's Co-operative Mercantile Institution. He founded this corporation originally to compete with the gentile establishments that sprang up when the railroad reached Utah. At present the institution operates a chain of department stores.

Brigham Young died at Salt Lake City Aug. 29, 1877, after a short illness. He left a fortune of more than 2 million dollars to his 17 surviving wives and their children. In all, Young married 27 times. After the death of his first wife, he married Mary Ann Angel, later known to his followers as "Mother Young." In 1842, after Joseph Smith had revealed the doctrine of plural marriage to the Mormon leaders, Young took another wife. He continued to add wives to his household until 1868, when he married for the last time. He had 56 children, including those who died in infancy and those brought into his family from his wives' previous marriages.

YOUNG MEN'S CHRISTIAN ASSOCIATION. On June 6, 1844, 12 young men in London organized a club for the "improvement of the spiritual condition of young men in the drapery and other trades." Their

A Y.M.C.A. SWIMMING CLASS



Many American boys learn to swim through the expert instruction offered by the Y.M.C.A. The "Y" operates summer camps in virtually all parts of the United States.

leader was a young Englishman, George Williams (1821–1905), who had come from the country to work in a London dry-goods house. Thus was our familiar Y.M.C.A. born.

America's first Y.M.C.A.'s were established in Boston and Montreal in 1851. Today there are associations in more than 50 countries of the world, and the membership is more than 2 million. Members are drawn from all races, and Y.M.C.A. buildings vary from thatched huts to skyscrapers.

Organization and Activities

The movement has had its greatest development in North America, where it now has more than a million members. There are associations in rural districts as well as in cities, and among special groups, such as railway employees, college students, the army, the navy, Indians, and Negroes. High-school students receive its benefits through Hi-Y clubs for boys or Tri-Hi-Y clubs for girls. There are also Gra-Y clubs for grammar-school boys.

Many associations provide living quarters in their hotels, as well as reading and social rooms, gymnasiums, and game rooms. They operate cafeterias, employment bureaus, and summer camps. Associations in the larger cities carry on extensive educational programs and offer vocational guidance. In addition to lectures and forums they offer high-school work and college courses leading to degrees in many fields. Other activities include religious meetings, dramatic and musical programs, trips, social events, athletic contests, and hobby shows.

In both World Wars the Y.M.C.A. operated service clubs for military personnel. In World War II it took the added responsibility of promoting educational and recreational facilities in many prisoner-of-war camps. It was charged with this duty by the Geneva Convention of 1929.

Each community organizes its own Y.M.C.A. and plans its activities, and each unit determines for itself who may become a member. Some associations admit women to membership. Local volunteer workers act as leaders of groups or as directors and committeemen. Special activities are directed by professionally trained leaders. A national council serves as a clearinghouse for the local units and renders various services to them. All the national associations are united in the World's Alliance, at Geneva, Switzerland.

YOUNGSTOWN, OHIO. A visitor to Youngstown hears talk of steel on all sides, for the livelihood of virtually everyone there depends upon steel. The city on the Mahoning River in northeastern Ohio is the heart of the third largest steel district in the United States. The flaring glow of steel mills and blast furnaces lights the valley for 25 miles, and the works extend into the adjacent Shenango and Beaver valleys of Pennsylvania.

Although the city's first steel plant was not built until 1892, Youngstown has been an iron-working

STEEL MILLS GLOW IN YOUNGSTOWN, OHIO

Blast furnaces and Bessemer converters light the sky for miles around Youngstown Ohio, as the production of steel goes on night and day. Most of the people in this city on the Mahoning River get their living from the steel mills and fabricating plants. Youngstown, which forms the center of the nation's third largest steel district, has been an iron-working city since 1802.

center almost from its beginning. It was founded in 1797 by John Young of Whitestown, N. Y. Just five years later, the first smelter was set up to produce iron from local ore, limestone, and coke. Even when failing local supplies later forced Youngstown to turn to Lake Superior ore and Pennsylvania coal, the city held its high rank as a producer of steel. A chief reason was its excellent transportation system. Youngstown is the only inland city between New York and Chicago served by four major railroad lines.

Steel is the basis of most of the city's manufactures. Principal products include automotive parts, rolling-mill equipment, wire, boilers, furnaces, tanks, metal sheet and tubing, radio towers, cranes, bridges, building materials, machinery, and furniture. From the mill coke ovens come such by-products as tar, benzol, toluol, and naphthas. Other manufactures are electrical equipment, mechanical rubber products, light bulbs, fine leathers, and paint. Nearby quarries supply lime for cement and brick.

Youngstown's park system features the large and scenic Mill Creek Park in the southwestern part of the city. It contains a nature museum and three lakes. Near the center of the city are Youngstown College and the Butler Art Institute.

The city was named for its founder. It was incorporated as a town in 1848 and as a city in 1867. Youngstown became the county seat of Mahoning County in 1876. It has a mayor-council form of government. Population (1950 census), 168,330.

YOUNG WOMEN'S CHRISTIAN ASSOCIATION. One of the best known and loved of modern emblems is the Blue Triangle of the Y.W.C.A. It is found in every large city of the nation and in hundreds of smaller communities. It signals a welcome to girls in many foreign cities. It stands for the Association's aim "to advance the physical, social, intellectual, moral, and spiritual interests of young women."

The Y.W.C.A. is of particular help to young women away from home. For example, a girl coming from a small town or farm to work in the city may find a room in a "YW" residence or in a private home that has been approved by the room registry. She may also take part in a wide range of social and recreational activities offered by the Association.

Taking care of strangers, however, is only one part of all that the Blue Triangle stands for. Thousands of girls stop school to earn their living. The "Y" offers them evening classes, where they may overcome educational handicaps or cultivate stimulating new interests. There are practical courses that teach typing and shorthand, English and speech, cooking, sewing, and millinery. There are classes also in cultural or social arts, such as dramatics, psychology, music appreciation, Spanish, and contract bridge. Discussion groups encourage girls to think and talk about their personal problems or world affairs. There are Bible classes and Sunday vesper services. Vocational counselors test a girl's qualifications and advise her on job requirements and opportunities. An employment bureau helps to place her in a position.

Blue Triangle secretaries know that many young women need a chance for exercise and recreation in the evening, so Association quarters usually include a large airy gymnasium and a swimming pool. There are physical fitness and reducing classes; dancing and swimming lessons; sports, such as archery, badminton, volley ball, and bowling. Parties and dances provide good times for the girls and their friends. Y.W.C.A. summer camps supply vacation sports and relaxation at reasonable cost.

Clubs are formed within the Association to foster special interests of various groups—business and professional women, factory workers, or student nurses. The industrial department may take over "Y" quarters for an "owl" party from midnight to dawn where late shift workers can find wholesome gaiety. At colleges and universities, student Y.W.C.A.'s offer Christian fellowship and counsel to girls "on their own" for the first time and seeking answers to perplexing questions of conduct and faith.

Girl Reserves Develop Leadership

The Girl Reserves, the junior members of the Association, carry on activities designed to help with the problems of growing up. Girls from 12 to 18 develop leadership by planning club programs, conducting meetings, and engaging in community service. Camps and sports offer healthful fun.

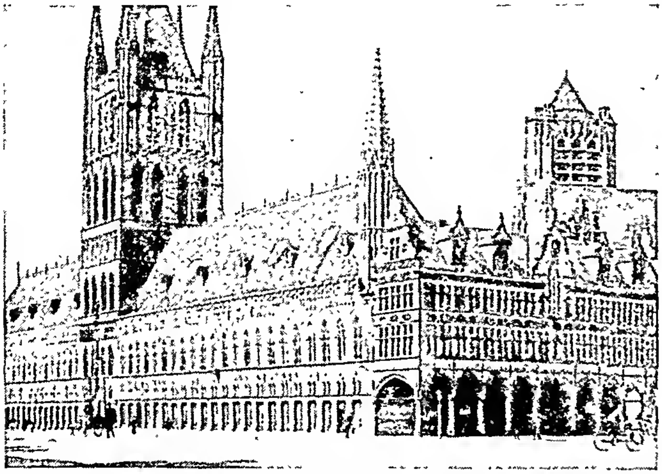
The Y.W.C.A. is a member of the Council of Social Agencies in most cities and shares in community funds. It supports worth-while social and economic movements, such as world peace and better interracial relations. As a member of the United Service Organizations, it operated service clubs near military, naval, and defense establishments in World War II. In World War I its Hostess Houses served the troops.

The Y.W.C.A. movement started in England in 1855 when Emma Robarts formed the English Prayer Union and Mrs. Arthur Kinnaird established a home for nurses returning from the Crimean War. A forerunner in the United States was the Ladies' Christian Organization of New York City, organized in 1858. The Young Women's Christian Association of Boston was established in 1866. Similar organizations sprang up over the country, and a National Association was formed in 1906. As the movement spread over the world, organizers from the United States helped to train the members to lead their own organizations and to become self-sustaining. By 1940 there were associations in 52 countries, banded together in the World's Council. Some 2,800,000 girls and women participate in the Y.W.C.A. program in the United States.

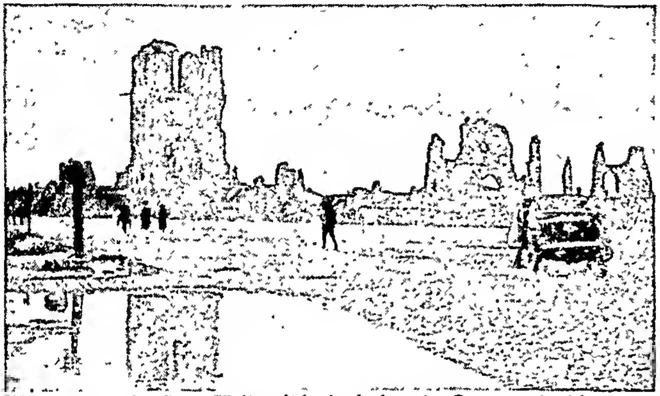
YPRES (*ē'pr'*), BELGIUM. No name connected with World War I will live longer in men's minds than that of Ypres—the "Wipers" of the British Tommies—a famous old city in West Flanders, 35 miles south of Ostend.

In the 13th century Ypres was one of the most important cities in western Europe and the center of the manufacture of woolen cloth. With the decline

EFFECT OF WAR ON A FAMOUS BUILDING



This picture shows a famous Gothic building, the Cloth Hall at Ypres, as it appeared before the first World War.



Here we see the Cloth Hall as it looked after the Germans had bombed Ypres between 1914 and 1918. It was later rebuilt.

of that industry and the passing of time, it became a quiet little town whose chief product was handmade lace. There remained, however, the beautiful Cloth Hall, one of the finest specimens of Gothic municipal architecture in Europe; the Gothic Butcher's Hall, with its museum of antiquities and paintings; and the medieval cathedral of St. Martin. These were the pride of the burghers and a witness to former glory. Then the first World War swept them all away. A battered "eity of the dead" huddled in ruins.

The Germans never held Ypres, but they bombarded it throughout the war. The battle of Flanders began with an attack on the city in October 1914. Just south of Ypres was fought the furious battle of St. Eloi in March 1915. The Allies straightened the resulting salient in 1917, but the next year the Germans threatened Ypres again.

After the war the city was largely rebuilt. The cathedral and the Cloth Hall were reconstrueted, and wherever possible, the original stones were used. The Menin Gate is a memorial to the thousands of British soldiers who died at Ypres. Population (1947 eensus), 17,052.

YUCATÁN (*yọ-kä-tän'*). The subtropical peninsula of Yucatán is famous for the ruins of aneient stone eities which lie buried within its jungles. The Maya Indians built these eities long before the white man came to Ameriea. Yueatán is famous also as the source of henequen, from which binder twine is manufactured, and of chicle, the basic ingredient of chewing gum.

The peninsula reaches northward from Central America toward Cuba, separating the Gulf of Mexieo from the Caribbean Sea. It is about 400 miles long by 200 miles wide. It includes British Honduras, the northern third of Guatemala, the Mexican states of Yucatán and Campeche and a corner of Tabasco, and the Mexican territory of Quintana Roo.

About 750,000 people live on the peninsula. The great majority are of Maya Indian stock. Some, particularly in the cities, are descendants of the Spaniards who conquered the peninsula in 1527–46 and ruled it until the 19th century. The people of British Honduras are chiefly of mixed white and Negro blood.

The northern part of Yucatán is flat. Hills and ridges rise to 300 or 400 feet near the middle and higher in the south. The greatest elevation is in the southwestern part of British Honduras, where the Maya Mountains reach heights above 3,000 feet.

Yucatán lies in the path of the trade winds. The temperature usually is between 60° and 80°F., though it occasionally falls to 40° or rises to 100°.

Rain, Vegetation, and People

The yearly rainfall averages about 20 inches in the northwest. The amount increases toward the south and east, averaging over 100 inches in the southern part of British Honduras. Most of the rain, particularly in the north, falls between May and October.

Vegetation increases with the increase in rainfall, ranging from scrub along the northern coast to jungle in most of northern Yucatán and rain forest in the south. The south-central part of the peninsula, the Department of Petén, Guatemala, consists of a central savanna, or grassland, surrounded by low ridges. These ridges and the valleys between were the first home of Mayan eulture. They were once densely covered by rain forest. Now the forest is interrupted by man-made savannas due to the Mayan method of corn farming (*see* Mayas).

Most of the peninsula's inhabitants live in the arid north rather than in the more fertile but forested south. Over two thirds live in the state of Yucatán and about half the remainder in the state of Campeehe. Their main food erop is corn, but they also grow beans, squash, tomatoes, sweet potatoes, and eassava. Most Indian families keep turkeys, pigs, and chickens. Cattle are raised in the north.

Henequen, one of the peninsula's two export crops, is raised in the north. It is a species of sisal (*see* Sisal). Landowners of Spanish descent used to raise it on huge plantations. Indians worked the fields for low wages. Under laws passed in 1937, the gov-

ernment bought all but 350 to 400 acres from most plantation owners and distributed the land among the Indians. The plantation owners rent their fiber-processing machinery to the Indians, who usually pay by labor in the owner's fields.

The henequen crop is sold through a state government co-operative. More than half goes to the United States. Most of the remainder is used in Yucatán to make cord and sacking; hammocks; bags and baskets; and such tourist articles as hats, handbags, and sandals.

Chicle, the second most important export crop, is gathered in the rain forest areas. It is the chief product of the state of Campeche, the territory of Quintana Roo, and Petén. British Honduras exports chicle, mahogany, and other tropical hardwoods. (*See also* Chewing Gum.)

Yucatán's Wells Are Famous

Limestone underlies almost all of Yucatán. In the northern part of the peninsula the rock is especially porous. Rain drains quickly into underground channels where it has hollowed out many caverns. Collapse of the roof of a cavern creates a great open well. The water may be more than 50 feet deep and the distance from its surface to the brink another 50 feet or more.

The people of Yucatán call these wells *cenotes* (*sā-nō'tās*). They are the only natural permanent source of fresh water in the northern half of the peninsula. The ancient Mayas believed certain cenotes were sacred. During religious ceremonies beautiful maidens were made to leap into them as a sacrifice to the rain god. Today man-made wells provide water for the people of northern Yucatán. The countryside and even modern cities such as Mérida bristle with windmills, which are used to raise the water.

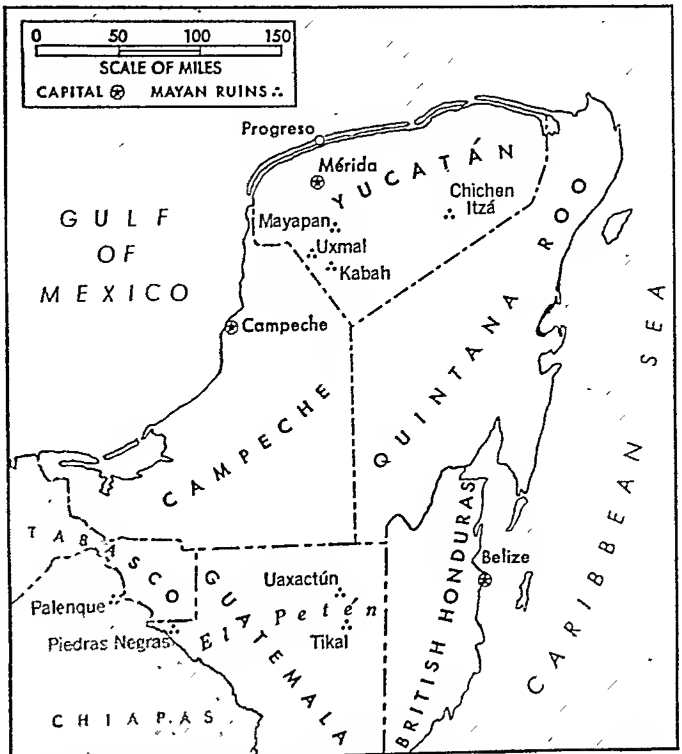
Cities, Ancient and Modern

Mérida, capital of the state of Yucatán, is the largest city on the peninsula, with a population of 144,793 (1950 census, preliminary). The henequen industry centers there. The city lies on the air lane between Mexico, Central America, and the United States. It is the point of departure for visits to the Mayan ruins at Uxmal, Kabah, and Chichen Itzá and as a result has a thriving tourist business. It is a colorful city of the Spanish type. Progreso (13,338), 23 miles to the north, is Mérida's seaport.

Campeche (31,274), capital of the state of Campeche, is the second largest city. It was a busy port in colonial days, but today, handicapped by the shallowness of its coastal waters, it sees few ocean-going vessels. Railroads connect Campeche with the Mexican mainland and with Mérida. The preparation of chicle for export is the city's chief industry.

The ancient Mayan cities in the northern part of the peninsula lie along modern highways. Those in the south are deep in tropical forest and are visited chiefly by archeologists.

THE SUBTROPICAL PENINSULA OF YUCATÁN



The peninsula contains British Honduras, the northern part of Guatemala, the Mexican states of Yucatán and Campeche and a corner of Tabasco, and the Mexican territory of Quintana Roo.

Yucca. The bold yucca, or Spanish bayonet, with its spike of creamy flowers thrusting upward from a cluster of swordlike leaves, is an ornamental feature of the landscape in the Southwest. New Mexico has eight species of this handsome plant. Our Lord's candle is a spectacular variety of southern Arizona and California. Two species grow in sandy places in the eastern half of the United States: eastern Spanish bayonet (*Yucca gloriosa*) and Spanish dagger (*Yucca aloifolia*). Gardeners cultivate various species, especially Adam's needle (*Yucca filamentosa*).

Several varieties of yucca are useful as well as ornamental. Soap can be made from the roots of soapweed (*Yucca glauca*) and palmilla (*Yucca elata*). Indians ate the fruit of soapweed. They used leaf fiber from palma (*Yucca macrocarpa*) and other species in making baskets, mats, and rope.

The way the yucca is fertilized is one of the wonders of plant life. The anthers of the flowers reach nowhere near the stigma, and the plant depends for reproduction on little white moths of the genus *Pronuba*. The female moth, attracted at night by the fragrant white blossoms, scrapes pollen from the anthers of one flower and shapes it into a pellet. Flying to another flower, she lays her eggs in the soft tissue of its pistil. Then she thrusts the pollen ball into the stigmatic funnel and rams it down with her head. Thus she pollinates the plant. The larvae feed on the seeds, but enough remain to produce new plants.

There are more than 30 species of yucca, a genus of the family *Liliaceae* native to the southwestern United States, Mexico, and Central America. Its flowers are usually white, bell-shaped, and pendulous. From the flower there develops a juicy berry in some species and a dry three-valved capsule in others.

The TROUBLED STORY *of the New* SOUTH SLAV STATE

Extent.—North to south, about 330 miles; east to west, greatest distance, about 370 miles. Area, about 96,000 square miles. Population (1953 census, preliminary), 16,927,275.
Natural Features.—Rivers: Danube, Sava, Drava, Morava, and Vardar. Mountains: Dinaric and Julian Alps, Karst Plateau, and Sbar. Climate: continental in interior with typical Mediterranean mildness on Dalmatian coast.
Products.—Corn, wheat, barley, oats, rye, potatoes, grapes, sugar beets, hemp, flax, tobacco, plums, apples, pears; horses, mules, asses, cattle, sheep, hogs, and goats; silk; timber, coal (chiefly lignite), iron ore, bauxite, copper, gold, lead, chrome, antimony, and cement; flour, cotton goods, carpets, boots, iron and steel.
Cities.—Belgrade (Beograd) (capital, population 469,988); Zagreb (Agram), Ljubljana (Laibach), Skopje (Uskub), Subotica (Maria Theresiopel), Sarajevo (over 100,000); Novi Sad (Neusatz), Fiume (Rijeka), Maribor, Nis (Nish) and Osijek (over 50,000).

YUGOSLAVIA. Among the nations created in Europe after the first World War was the "Kingdom of the Serbs, Croats, and Slovenes," which later changed its name to Yugoslavia, or Land of the South Slavs. After the second World War, Yugoslavia became a Communist "people's republic" with Marshal Josip Broz ("Tito") as dictator. Russia and Yugoslavia signed a 20-year friendship pact in 1945. In 1948 Stalin denounced Tito for refusing to take instruction from Moscow. The two countries became bitter enemies, and Tito was forced to pursue an independent Communist policy. Fear of Russia made Yugoslavia an uneasy ally of the West in its struggle with the Soviet Union.

The Land and Its Resources

The largest of the Balkan countries, Yugoslavia spreads inland from the Adriatic Sea to touch on several other nations. The greater part lies in the fertile Danube basin. Across this rolling plain the Sava River flows east to join with the Danube at Belgrade, the capital city. South and west of the plain rises a maze of highlands, culminating in the Dinaric Alps. Along the sea the mountains drop off sharply to a narrow, island-fringed coast, known as Dalmatia. Dalmatia has the mild and sunny Mediterranean climate. In the interior the valleys have freezing temperatures in winter and the highlands are blanketed with snow.

In soil and forests, in mineral deposits and potential water power, Yugoslavia has rich natural resources. Industries, however, are little developed. Four-fifths of the people are farmers and shepherds.

Corn and wheat are the chief grains, followed by barley, rye, and oats. Beans and peas are also raised. The leading industrial crops are sugar beets, hemp, hops, opium, tobacco, cotton, and flax. Vineyards thrive everywhere and plum orchards flourish in the mountain valleys. Millions of sheep are pastured on the uplands.

YUGOSLAV TYPES

Many Yugoslavs disregard Western fashions and retain the national costume. Note the man's fezlike cap and the woman's silver belt. The costume varies with the land's many regions.

Forests cover a third of the country and lumbering is an important industry. The country is rich in mineral resources—iron, copper, gold, lead, manganese, chrome, antimony, bauxite, and coal (chiefly brown coal). All mines and industries are now state-owned. In 1947 the government began an ambitious five-year plan to transform the backward agricultural country into a modern industrial state. Men and women were taken from farms to work in mines and heavy industry. Light industries were neglected, creating a shortage of consumer's goods. Food also became scarce. The government slowed down the collectivization of farms. But compulsory delivery of grain to the state left small farmers little incentive to produce.

Transportation and Chief Cities

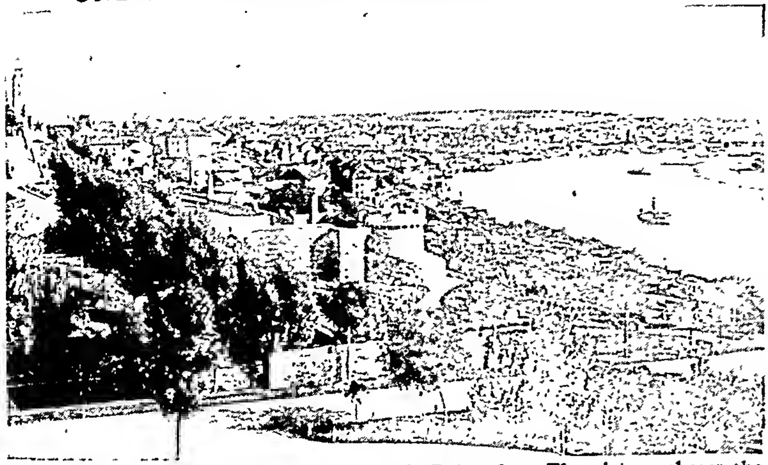
The harbors along the Dalmatian coast are almost inaccessible from the interior. Some commerce passes through the ports of Fiume and Trieste at the head of the Adriatic, over which Yugoslavia has at various times tried to establish its control (*see* Fiume; Trieste). The chief means of communication with other countries lies through the Danube Valley, leading north and east. Separate railway systems, some ending "in the air," were inherited from the old provinces and kingdoms out of which the country was pieced together. Belgrade, the capital, and Skoplje are the principal cities in the Serbian part of the kingdom. Zagreb is the chief city of Croatia-Slavonia; and Ljubljana, of Slovenia. Subotica and Novi Sad are the chief cities of the Voyvodina district, formerly a part of Hungary. In Bosnia is Sarajevo, where an assassin fired the shot that started the first World War.

A House Divided against Itself

Yugoslavia was formed out of the kingdoms of Serbia and Montenegro and parts of the former Austro-Hungarian Empire, including Bosnia and Herzegovina, most of Dalmatia, Croatia-Slavonia, Slovenia, and the Voyvodina. The various peoples were related by blood, but they had lived under different masters and had developed widely different ideas and ways of living. The Croats and Slovenes had the highest culture, acquired from Budapest and Vienna. Their customs were those of Western Europe and their religion was Roman Catholic. The Serbs had lived under the rule of Turkey; their religion was Greek Orthodox. The different groups had worked together to create an independent nation, but friction among them arose as soon as independence was achieved.

The Serbs comprised more than a third of the total population and had a well-organized national administration at Belgrade. With the exception of the Montenegrins, they alone had experience in self-

ONE OF BELGRADE'S RIVER HIGHWAYS



Where the Sava joins the Danube, there is Belgrade. The picture shows the improved port on the Sava, a trade center for river steamers from all over the Balkans. The city was heavily damaged in the second World War.

government. Besides, Belgrade's position at the crossing of great highways made it the logical capital of the new kingdom. From the beginning the Serbs assumed leadership in the new state. In the closing months of 1918 Prince Regent Alexander of Serbia was made king of Yugoslavia.

The Croats and Slovenes wanted a federated state that would allow them local self-rule. The Serbs favored a strong central state under Serb domination, and achieved their goal in the constitution adopted in 1921. Trouble between Serbs and Croats reached a climax when a Serb deputy shot and killed the Croat leader Stephan Raditch on the floor of parliament. The breakup of the kingdom seemed likely until King Alexander, in January 1929, suspended the constitution and made himself dictator.

Allying itself with other Balkan states that wanted to preserve the boundaries laid down in 1919, Yugoslavia joined the Little Entente with Czechoslovakia and Rumania and later the Balkan Entente with Greece, Turkey, and Rumania. In 1934, fearful of Germany's growing power, Alexander decided to appeal for protection to France, and journeyed to Marseilles. There he was assassinated by a Macedonian terrorist. He was succeeded by his 11-year-old son, Peter II, under a regency of three persons dominated by Alexander's cousin, Prince Paul.

Invasion and Resistance

In the early years of the second World War, Yugoslavia found itself virtually encircled by German conquests. In March 1941 Prince Paul induced the government to yield to Germany's demand for coöperation. Resentment swept the nation. After two days of disorder the army overthrew the regency and made Peter nominal ruler. On April 6 Germany invaded Yugoslavia, bombed Belgrade, and conquered the nation in 12 days (*see* World War, Second). King Peter escaped to London where he set up a government in exile. At home the Yugoslavs steadily attacked the Nazis in guerrilla warfare.

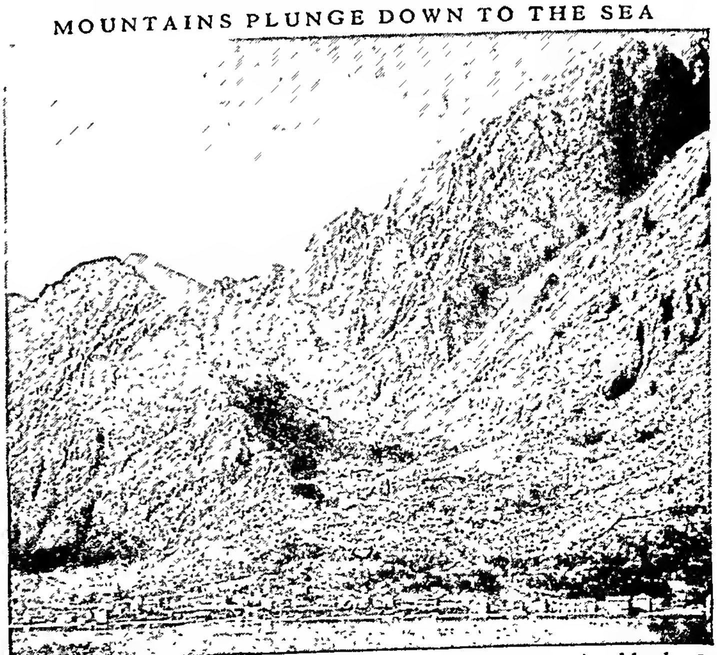
General Draja Mihailovich, a Serb, organized a guerrilla force called Chetniks ("committeemen"), which received aid from the United States and Britain. Soon Josip Broz, a Croatian Communist who called himself Tito, established another guerrilla army, the Partisans. The Partisans defeated the Chetniks and harried the Nazis so effectively that the Allies transferred their aid from Mihailovich to Tito.

In October 1944 Russian forces joined Tito to free Belgrade from the Nazis. In 1945 Tito set up a Communist government with himself as dictator and barred King Peter from the country. In 1946 a new constitution, similar to that of Russia, renamed the country the Federal People's Republic of Yugoslavia. The federation includes six "people's republics"—Serbia, Croatia, Slovenia, Bosnia and Herzegovina, Macedonia, and Montenegro. As in other Communist countries, the government proceeded to weaken the churches, control the press, and put down political opposition by means of a secret police.

In 1947 Italy ceded to Yugoslavia several Dalmatian islands, along with Istria and Venezia Giulia. Tito demanded Trieste, but it was made a "free territory" under the United Nations (*see* Trieste).

Russia wanted to exploit Yugoslavia as a colony. Tito aimed to build up a strong independent state. In 1948 Russia denounced Tito and broke its treaty of friendship and trade. Its satellite countries followed

MOUNTAINS PLUNGE DOWN TO THE SEA



The Gulf of Kotor (Cattaro) ranks among the world's best natural harbors. Like Yugoslavia's many other Adriatic harbors, it has little traffic because of poor communications with the interior. Stern limestone mountains with few passes—the Dinaric Alps, a southward extension of the Alpine chain—wall off the Dalmatian coast from the rest of the country.

suit. Tito continued Communist methods in an effort to industrialize his nation and to collectivize agriculture. Economic trouble and the threat of Russia forced him to ask aid from the West. Because of Yugoslavia's strategic value, the United States in 1950–53 sent money and arms. To step up production, Tito in 1953 canceled many Communist controls, such as fixing prices and forcing farm collectivization. He also changed the constitution to give local governments more responsibility. He was then elected the first president of the federated republics and was reelected in 1954 for four years. (For Reference-Outline and Bibliography, *see* Europe.)

YUKON (*yo̤'kŏn*) **RIVER.** Because there are almost no railroads in the mineral-rich Yukon Territory and in east central Alaska, the Yukon River is the chief means of transportation for this vast region. It is the largest river of Alaska and the fifth largest in all North America. Few rivers are navigable for so large a proportion of their length. Except for a few miles of rapids, it is open in summer to steamboat navigation for its entire length—close to 1,800 miles—from Lake Bennett to the Bering Sea. Small steamboats have descended the entire series of rapids; but on the up-journey the most extensive, the White Horse, is impassable. At this point a railway links the navigable parts of the river.

The Yukon is remarkable in that it rises within 15 miles of the Pacific Ocean and finally, after flowing in a great arc, reaches the same ocean again on the west coast of Alaska. The river in its first few hundred miles is known as the Lewes. It has its source in small streams of Chilkoot Pass in British Columbia. Its main forming basin is Lake Bennett (altitude 2,160 feet) on the southern boundary of Yukon Territory. Through this it flows north and northwest to enter Alaska. Here it continues northwest to the Arctic Circle, then turns abruptly to flow southwest most of the remaining way to the sea. In most of its upper course it is shallow and narrow, expanding at intervals into lakes.

Where the Lewes joins the Pelly River, about 175 miles below the rapids, the Yukon proper begins. The Yukon has other large tributaries—the White, Stewart, Klondike, and Fortymile rivers in Canada; and the Porcupine, Tanana, and Koyukuk rivers in Alaska.

The Vast Area Drained by the Yukon

The Yukon's drainage basin, which covers more than 330,000 square miles, is about the size of Texas and Oklahoma together. Most of this basin is mountainous and hilly, with wooded valleys. There are also flat marshlands. The largest of these, the Yukon Flats, flanking the river near the Arctic Circle, is more than 100 miles long and 40 to 100 miles wide. Here the river itself becomes from 10 to 20 miles wide.

In Yukon Territory the chief ports on the river are White Horse, on the Lewes, and Dawson, where the Yukon and Klondike rivers meet. Dawson is the port for the gold-mining Klondike region. In Alaska the chief river towns are Fort Yukon and Tanana.

YUKON TERRITORY, CANADA. Few people know this untamed region in the northwestern corner of Canada, except from stories about the men who sought its gold. With an area of 207,076 square miles, it is about one third the size of Alaska, but a small town could hold all its people. It stretches north from British Columbia to the Arctic Ocean and west from the Northwest Territories to Alaska.

Most of the Yukon is mountainous. In the extreme southwest is the St. Elias Range, containing Canada's highest mountains. These are Mount Logan (19,850 feet) and Mount St. Elias (18,008 feet), the latter on the Alaskan border. The Yukon River and its tributaries drain the central Yukon Plateau.

The climate is typically continental, with extremes of temperature from 95° F. in summer to −68° in winter. The winter average is 0° to −20°; the summer average, 50° to 60°. The mountains on the west cut off much rain and snow. Thus the precipitation for a whole year ranges between only 7 and 19 inches.

In summer the sun shines 20 hours a day, and such crops as potatoes, turnips, oats, rye, barley, and hay ripen in an astonishingly short time. Most of the food supply, however, must be imported. There are forests of spruce, birch, and poplar, but relatively few trees attain sawmill size. Caribou, moose, bears, and small fur animals abound.

Gold Rush, Government, and People

In 1897 and 1898 the Yukon was the scene of a wild gold rush set off by the finding of gold in Bonanza Creek, a tributary of the Klondike River (*see* Klondike). Where a few Indians had lived, thousands of prospectors now crowded in. Local government to keep order was lacking. The Yukon, until then a part of the Northwest Territories, was made a separate territory in 1898. Dawson, the center of the gold rush, was made the capital. The population was more than 27,000 in 1901 but declined to 4,914 by 1941. The 1951 census gives 9,096. The rich placer deposits are depleted. Hydraulic equipment and dredges are needed to mine gold profitably. Silver and lead are produced around Mayo on the Stewart River. Fur trapping provides income. In some years it surpasses mining. A commissioner appointed by the federal government and an elected council of five members administer the government. The territory elects a representative to Canada's House of Commons.

The 1,523-mile Alaska Highway between Dawson Creek, British Columbia, and Fairbanks, Alaska, crosses the southern part of the territory. It was completed in 1943. White Horse, on the highway, is a growing transportation center (population, 2,594, 1951 census). In 1951 it replaced Dawson as the capital. It has a modern airport and facilities for motor vehicle travel. It is also the terminus of the White Pass and Yukon Railway, 111 miles long, to Skagway, Alaska. In summer, steamboats carry passengers and freight to many points of the interior on the Yukon River and its tributaries. In winter, travel is largely by airplane. (For Reference-Outline and Bibliography, *see* Canada; Canadian History.)

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ZAMBEZI (*zăm-bē'zĭ*) RIVER. Although the lower region of the Zambezi, for at least 300 miles from its mouth, has nominally been in the possession of the Portuguese since the beginning of the 16th century, it was only in the last half of the 19th century, through the reports of Livingstone and other explorers, that the world gained definite knowledge of this great stream. It was then revealed that the Zambezi is the fourth river in size in Africa with a length of 2,200 miles, and that it rises in a black marshy bog in the northwestern part of what is now the British territory of Rhodesia, and flows south and east, discharging into the Indian Ocean. In its upper course the Zambezi flows through dense forests, alternating with an open bush country, with extensive stretches of flat country subject to widespread floods. At the eastward edge of the central plateau of Africa are located the Victoria Falls (*see* Victoria Falls), the greatest waterfall in the world. The Zambezi is navigable for stern-wheel steamers from the sea to beyond Tete, a distance of 400 miles. Long stretches up-stream are also navigable, providing local transportation.

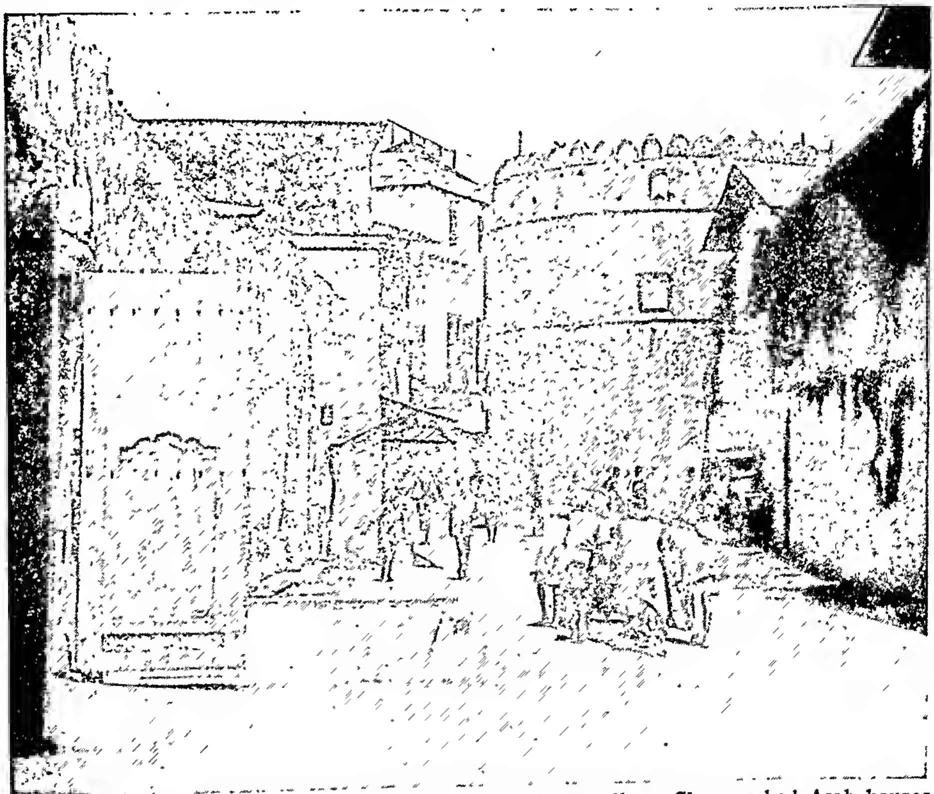
ZANZIBAR. "When you play on the flute at Zanzibar," says an Arab proverb, "all Africa as far as the lakes dances." This tiny speck of an island lies close to the east coast of Africa, just south of the Equator. For centuries it was the leading African port on the Indian Ocean. Sailing vessels stopped here on their way to the Indies, and a rich trade in slaves and ivory was carried on by the shrewd Arab traders who dominated the island.

Zanzibar was conquered by the Portuguese in the early 16th century, but passed back into the hands of the Arabs in 1730. In 1832 the sultan of Muscat, who controlled much of the eastern coast of Africa, made the town of Zanzibar the capital of his empire. The commerce of the island declined when the European powers, in a scramble for influence and possessions in Africa, broke up the sultan's empire and built ports on the mainland, which absorbed much of Zanzibar's trade.

Today Zanzibar and Pemba, its sister island to the north, are renowned for cloves. Here grow more than three-quarters of all the cloves raised in the world. The sultans introduced the spice to the islands and compelled plantation owners to set out clove trees. Arab planters prospered so long as they were able to use slave labor. When slavery was abolished after 1897, many plantations passed into the hands of Indian, European, or native owners. Coconut growing is the second industry of the islands.

The town of Zanzibar, on a triangular peninsula on the west side of the island, 6 degrees south of the Equator, combines the picturesqueness of the tropics and the Orient. The towers of Mohammedan mosques rise from narrow streets lined with white-walled, red-roofed houses. Richly carved black doors open to offer glimpses of patios where fountains splash and acacia trees flaunt their bright blossoms. The harbor teems with every kind of craft—British warships and mail steamers, battered cargo ships and Arab *dhows*. The city's population is even more varied. Negroes are numerous, for people of every African tribe have come to the islands to work on the clove plantations. Arabs are second in number and British

THE CLOVE CENTER OF THE WORLD

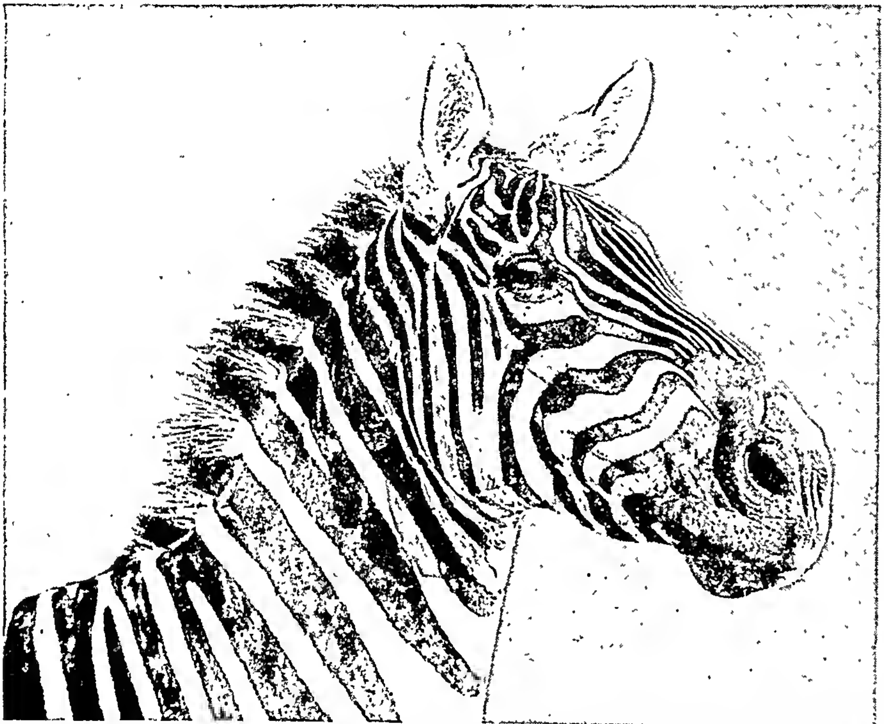


An old Portuguese fort juts into this narrow street in Zanzibar. Close-packed Arab houses give the town an oriental look, but the population is chiefly African. The heavy cart which the Negroes are pushing probably contains bales of dried cloves.

Indians third. There is also a scattering of traders from many countries of Europe and Asia.

Zanzibar, Pemba, and the adjacent small islands have been a British protectorate since 1890, though the sultan continues to exercise some authority. Zanzibar is 50 miles long and 24 miles wide, and has an area of 640 square miles. It is separated from the African coast by a reef-filled channel 22 miles wide. The area of Zanzibar protectorate is a little more than 1,020 square miles, and it has a population of 264,162 (1948 census). The city of Zanzibar has 44,359 inhabitants.

A FACE THAT CAN VANISH IN THE SHADOWS



This museum exhibit of Grant's zebra shows how head, neck, shoulders, and mane are striped for camouflage in forest shadows. In the open, the zebra grazes with gazelles and wildebeests that warn it of danger. Grant's zebra ranges from Tanganyika north into the Sudan.

ZEBRA. On grassy African tablelands from Ethiopia south to the Cape of Good Hope, graze the fleet and wary zebras, those famous members of the horse family that wear stripes. Though hunted ruthlessly by men and lions, Grant's zebra (*Equus granti*) still roams East Africa in large herds. It stands four and one-half feet tall at the shoulders. Its general color is pale yellow-brown, with dark brown to black stripes on head, body, legs, and tail. Burchell's zebra (*E. burchelli*), found from Ethiopia to South Africa, and Chapman's zebra (*E. chapmani*), of Tanganyika, have shadow stripes between the large ones. Burchell's zebra is wrongly called the quagga. The true quagga, now extinct, was a wild ass and had no stripes at all on its legs.

In Ethiopia lives the largest species, Grevy's zebra (*E. grevyi*), five feet tall at the shoulders. It is noted for its enormous ears and its numerous narrow stripes, jet black on a pure white background.

Only about four feet tall at the shoulders, the true or mountain zebra (*E. zebra*) of the Cape of Good Hope is the smallest of the race. It displays broad black stripes on a white coat. Once abundant, it has been hunted until only a few scattered herds survive.

Though it can be made to work in harness, the zebra is still too wild to be trusted. The flesh is eaten by African natives and the hide is used for leather.

ZEBU (*zē'bū*). The humped ox of India, called by foreigners the zebu, is no longer found in the wild state, but has become thoroughly domesticated. It possesses a well-marked hump of fat on the shoulders which is considered a delicacy. It has long ears pointing downward and short blunt horns. Zebus are used for plowing, hauling, riding, and for milk. The white bulls are held sacred by the Hindus. Under the name of "Brahman" cattle, zebus have been imported into Texas and crossed with nativestock (*see* Cattle). Scientific name, *Bos indicus*.

ZEUS (*zūs*). The greatest of the deities in classical mythology was called Zeus by the Greeks, Jupiter or Jove by the Romans. He was the father of gods and men, protector of kings and supporter of law and order, the avenger of broken oaths and other offenses; he watched over the state and the family and over strangers and suppliants; his hand wielded the lightning and guided the stars; he gathered the rain clouds; he ordained the changes of the seasons, and regulated the whole course of nature.

The son of Kronos and Rhea, Zeus, according to the ancient story, expelled his father and the older dynasties of the Titans. Then he assumed the sovereignty of the world and successfully resisted the attacks of the giants and the conspiracies of the other gods (*see also* Rhea). After the dethronement of the Titans, Zeus was allotted the empire of heaven and air, Hades (Pluto) of the infernal regions, and Poseidon (Neptune) of the sea, while the earth was left under the joint power of the three.

Zeus himself, however, was supreme over all. To his palace on Mount Olympus all the gods repaired to take counsel and to settle the affairs of men. The power and majesty of the ruler of the world is expressed in Homer's famous lines:

> Zeus spake, and nodded with his shadowy brows;
> Waved on the immortal head th' ambrosial locks,
> And all Olympus trembled at his nod.

The wife of Zeus was Hera (Juno), the queen of heaven, and their union was regarded as the divine type of all earthly marriage. Zeus was not always faithful to Hera but had numerous other love affairs. Some authorities explain this by saying that many adventures properly belonging to other gods were ascribed to Zeus.

When Zeus was shown as judge and ruler, he was seated upon a throne, a scepter in his hand. As commander of the forces of nature he rode in his thunder-car, wearing the aegis or breastplate of stormcloud (sometimes worn by Athena), hurling the thunderbolt and the lightning scourge. The eagle, the oak, and the mountain peaks were sacred to him.

The highest achievement in Greek sculpture was said to have been a statue of Zeus by Phidias, in the great temple of Zeus at Olympia. It was a colossal figure of ivory and gold, made about the middle of the 5th century B.C. Descriptions of its splendor have come down to us, and its design is well known from its image stamped on certain Greek coins.

ZINC. Most of us have noticed the coating of zinc on buckets, rainspouts, wire fences, and other things made of galvanized iron or steel. But few people know about the many other uses for zinc. All brass contains zinc. Typewriter frames, safety-razor holders, and automobile horns, radiator grilles, and door handles are among the many articles made of zinc alloys. Paint on the walls of our houses and some ointments and powders in our medicine cabinets probably contain zinc. But in most of its countless applications the zinc is concealed.

For hundreds of years, indeed, men used zinc without knowing what it was. The Romans fused its ores with copper to make brass. The first to recognize zinc as a distinct metal were the Hindus and the Chinese. By the 16th century, Portuguese traders were bringing zinc bars to Europe from the Orient. Perhaps the first European to produce metallic zinc was Georgius Agricola. In his work 'De Re Metallica' (1556), he tells of finding "zincum" in furnace crevices while smelting lead and copper ores.

The process of galvanizing iron consumes a large share of the zinc produced today. Immersion in molten zinc gives iron a rustproof coat. In the process of electrogalvanizing, the iron is electroplated with zinc (*see* Electroplating).

Brass making usually ranks second in the use of zinc, for the different types of brass contain from 30 to 40 per cent of zinc (*see* Brass). Die-casting also consumes large amounts of zinc. Typical alloys used for this purpose contain 90 per cent or more of zinc with small quantities of copper and aluminum. Die castings of these alloys are light and durable and require little finishing.

For many purposes, zinc is simply flattened into sheets called rolled zinc. These are used to make roofing, battery cans, refrigerator linings, photo-engraving sheet, and tops for glass jars.

The compounds of zinc have important uses. Zinc oxide, or zinc white, is used in paint to give it body and to make it opaque (*see* Paints and Varnishes). It is used in rubber to make it heat resistant. Zinc chloride is used in soldering flux, and zinc sulphate in fungicides and insecticides. Zinc compounds are used also in medicines and toiletries.

Ores and Producing Regions

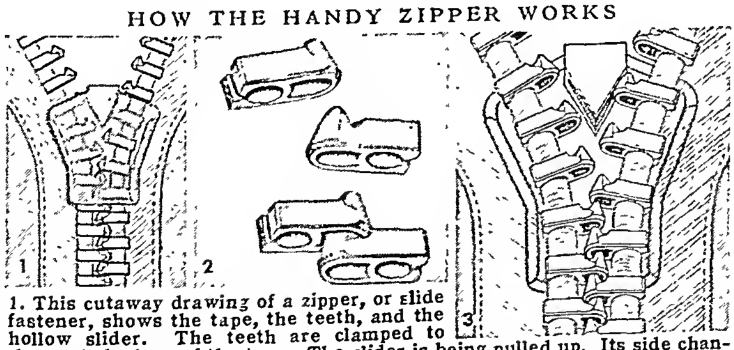
The chief ores are zinc blende or *sphalerite* (a sulphide), *smithsonite* (a carbonate), *calamine* (a silicate), and *franklinite* (an oxide). At the smelter the zinc is distilled from crushed ore. This is done by heating the ore with coal in retorts, thus freeing the zinc as a vapor. Finally the vapor is condensed to liquid. This is poured into molds, and it solidifies into slabs (*spelter*). Zinc is also separated from the ore by electrolysis (*see* Electrochemistry).

The United States leads the world in zinc production. The chief mining center is the Joplin region, where Oklahoma, Kansas, and Missouri meet. New Jersey, Tennessee, Virginia, Idaho, and New York have deposits of commercial value. Important foreign producers are Germany, Belgium, Canada, Australia, the United Kingdom, Russia, and France.

Though the world has abundant reserves of zinc ore, the normal output is not enough to meet the needs of nations in times of war. Zinc is therefore considered a "strategic material," and nations at war severely curtail civilian uses.

Pure zinc is bluish white and fairly soft. With a specific gravity of 7.14, it is almost as heavy as tin. The melting point of zinc is about 787° F., and its boiling point, exceedingly low for a metal, is about 1,665°. Its chemical symbol is Zn; atomic number, 30; atomic weight, 65.38; and valence, 2.

HOW THE HANDY ZIPPER WORKS



1. This cutaway drawing of a zipper, or slide fastener, shows the tape, the teeth, and the hollow slider. The teeth are clamped to the corded edges of the tape. The slider is being pulled up. Its side channels guide the teeth into closed position. 2. This shows how each tooth is wedged above and cupped below. The slider moves the wedged part of each tooth into the cup of the tooth above. 3. Pulling down the arrowlike top of the slider forces the teeth to open.

ZIPPER. The word "zipper" is applied to many articles. Most commonly it means a slide fastener, used in place of buttons, hooks and eyes, or laces. A slide fastener is made of two rows of metal teeth, clamped to the corded edges of tapes. The teeth are opened and closed by pulling a hollow Y-shaped slider. Each tooth is opposite a space between two teeth on the other row. Each channel of the Y-shaped slider

moves over one row of the teeth, guiding them at an angle into the opposite spaces. As the two rows of teeth mesh, the single channel of the slider passes over them. When joined, the teeth cannot be separated except by pulling the slider down to unmesh them.

The first slide fastener was patented by Whitcomb L. Judson of Chicago in 1893. This was a series of hooks and eyes joined by a slider. The first practicable mesh-toothed slider was designed by Gideon Sundback of Meadville, Pa., in 1913.

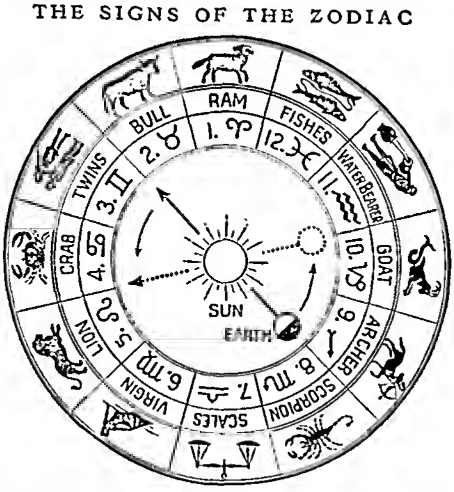
ZODIAC. Wherever the sun stands in the sky, it hides some constellation of stars with its light. As the earth moves around the sun during the year, the sun *seems* to move eastward against the background of constellations (*see* Astronomy). The planets and the moon also seem to shift gradually around the sky, past the same constellations.

Ancient peoples believed that these motions controlled the fates of men, and so they studied them carefully. They identified 12 constellations which the sun passed through in successive months. They called the entire band the *zodiac*, from Greek terms meaning "circle of animals." The names and the order of the constellations as the sun passes through them can be remembered by this rhyme:

> The Ram, the Bull, the Heavenly Twins,
> And next the Crab the Lion shines;
> The Virgin, and the Scales,
> The Scorpion, Archer, and the Goat,
> The Man that Bears the Watering Pot,
> And Fish with glittering tails.

Usually, however, the constellations are known by their Latin names: Aries (Ram), Taurus (Bull), Gemini (the Twins), Cancer (Crab), Leo (Lion), Virgo (Virgin), Libra (the Balance, or Scales), Scorpius (Scorpion), Sagittarius (the Archer), Capricornus (Goat), Aquarius (the Water Bearer), and Pisces (the Fishes).

THE SIGNS OF THE ZODIAC



Here are pictured the 12 signs of the zodiac with their numbers, English names, and symbols. The diagram in the center shows why the sun is said to pass through the 12 signs during the year.

As a result of the shifting of the equinoxes, the sun is now a whole constellation behind the appropriate sign. For example, at the beginning of spring the sun is said to enter the sign of Aries, but as a matter of fact it is still in the constellation Pisces. Two thousand years ago, however, the signs and the constellations exactly corresponded with each other. This will not be true again for nearly 24,000 years. (*See also* Constellations.)

ZOLA (*zō'lä*), **ÉMILE** (1840–1902). As a writer Émile Zola waged two great battles. The first was his long struggle for the acceptance of his powerful and realistic novels. The second was his courageous defense of Capt. Alfred Dreyfus in the political-military scandal that divided France. Zola won both these fights. The critics and the public realized his novels were serious studies of mankind; and Dreyfus was exonerated after long years of imprisonment.

Zola was born April 2, 1840, in Paris. His father was an Italian-Greek engineer, his mother a Frenchwoman. When Émile was two the family moved to Aix-en-Provence in the south of France. His father died soon after; and his mother struggled to support herself and the boy. Émile's closest friend was Paul Cézanne, who later became a great painter.

In 1858 Zola returned to Paris. After two years of school at the Lycée St. Louis, he worked at odd jobs and began writing. Success came slowly and Zola lived a meager, garret existence for years. But with the publication of 'Thérèse Raquin' (1867) his name became known. Then he launched on a series of 20 books called the Rougon-Macquart novels. These took him about 22 years to complete.

In the Rougon-Macquart novels Zola attempted to show men as products of their heredity and environment. He portrayed them as passive creatures with little free will, victims of their own passions and of the circumstances into which they were born. Like many reformers, Zola chose extreme examples to prove his points. But whether or not his stories are balanced presentations of human life, Zola's writing is full of vivid description and swift-paced narrative.

At the close of his career Zola enjoyed wealth and acclaim. But he could not help taking sides in the most flaming issue of his time—the Dreyfus affair. Dreyfus had been convicted of selling military secrets to the Germans and had been sent to Devil's Island. Zola became convinced that Dreyfus was innocent and that his sentence concealed the guilt of others. In a leading newspaper he published a burning document called 'J'Accuse' (I accuse) which led to his own trial and the reopening of the Dreyfus case. Both men were vindicated completely. Zola died Sept. 29, 1902, asphyxiated by a faulty chimney in his bedroom.

With Flaubert, the Goncourts, and others, Zola helped found the "naturalist" school of French literature. Their concentration on misery and misfortune swung public taste away from false romanticism to a middle road of balanced taste.

Zola's best-known works are: 'Contes à Ninon' (1864); 'Thérèse Raquin' (1867); the Rougon-Macquart series (1871–1893), including 'L'Assommoir' (The Dramshop), 1877, 'Germinal' (1885), 'La Débâcle' (The Downfall), 1892, and many others; 'Nana' (1880); a trilogy, 'Les trois villes' (The Three Cities), including 'Lourdes' (1894), 'Rome' (1896), 'Paris' (1898); another series, 'Les quatre évangiles' (The Four Gospels), including 'Fécondité' (Fruitfulness), 1899, 'Travail' (Labor), 1901, 'Vérité' (Truth), 1902. The last volume of this series was never completed.

How Modern ZOOS KEEP *Wild* ANIMALS *Happy*

ZOO. Only a few people can go to the jungles of India or the rocky plains and grasslands of Africa and see tigers, elephants, monkeys, and lions living in the wild. A zoo gives everyone a chance to meet these animals and many others.

The word "zoo" is a short term for "zoological garden." Zoology is the science of animals. The word "garden," of course, means the place or park where the animals are kept and shown to visitors.

Why does nearly everyone enjoy a visit to the zoo? Is it only because the animals are so strange? Perhaps some people wonder what would happen if the animals escaped—what the animals would do and what the people would do. Others want to know where the animals came from, how they were captured, what they eat. Some people wonder if the animals are happy. These questions can be answered by going behind the scenes and seeing how a great modern zoo is operated.

A favorite of everyone who visits the zoo is the elephant. This big Asiatic elephant is having his toenails filed, a job on a scale with his great bulk. Notice the size of the file and the special footrest.

How Animals Are Shown in Modern Zoos

The older type of zoo is a park with fenced enclosures and buildings containing caged animals. Lions, tigers, and other cats are kept in one house; monkeys in another. People who plan zoos know that animals in bare cages are not very interesting. It is better to show them living as they did when they were wild, in surroundings that imitate the scenery and plant life of their native homes. Different animals and birds that live together in desert, plain, or jungle may be shown in one exhibit, known as a *habitat* group.

Visitors to this modern zoo are surprised to look across a small open plain and see lions apparently free to wander about as they please. Nearby are ostriches and cranes, antelopes and zebras feeding quietly at the edge of a water hole. They are not afraid of the lions because they are separated from them by wide, deep trenches, or moats. Moats also separate the visitors from the exhibit. The moats are cleverly hidden with plants and the visitor does not notice them. He feels that he is seeing the animals living wild in their natural settings.

Experience has shown that lions cannot jump so far as 30 feet in a straight line and six feet upward. They can be held on a sort of "island" by moats about 35 feet wide and a wall at least six feet high to protect the visitors. Pumas and leopards make tremendous leaps and must be kept in cages.

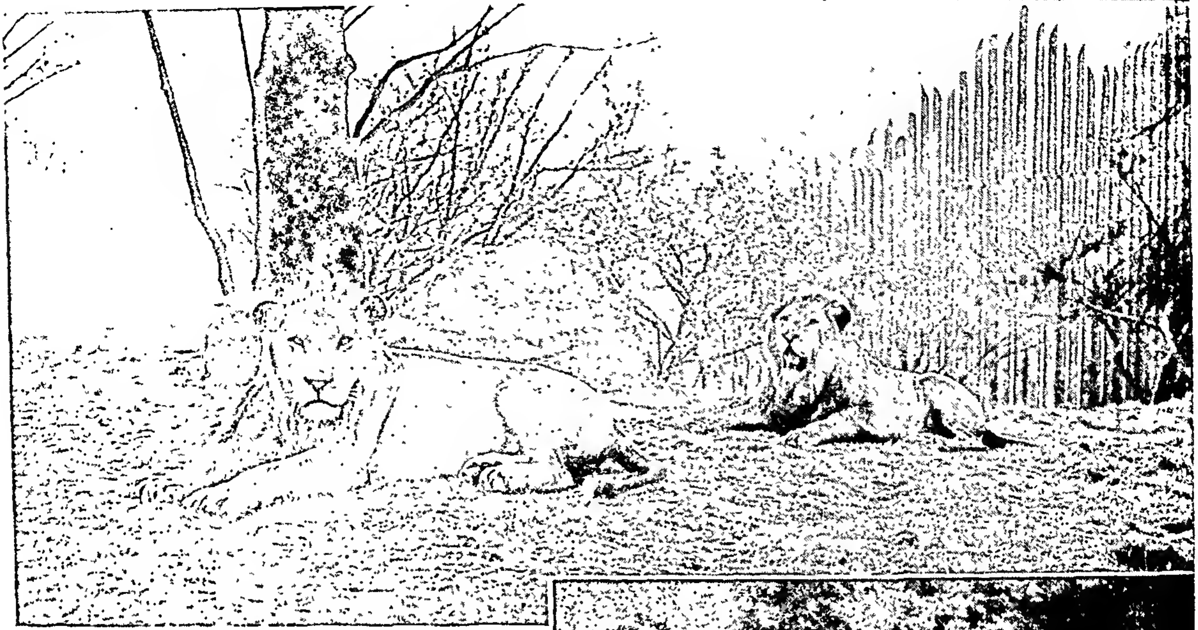
"Monkey islands" are another example of out-of-doors display. Some monkeys refuse to enter water. They can be held by a water-filled ditch with a guard rail on the visitors' side. Other monkeys are swimmers. To hold them in, a fairly high wall, inclined inward toward the island, is added to the water moat.

Bird Enclosures and Flight Cages

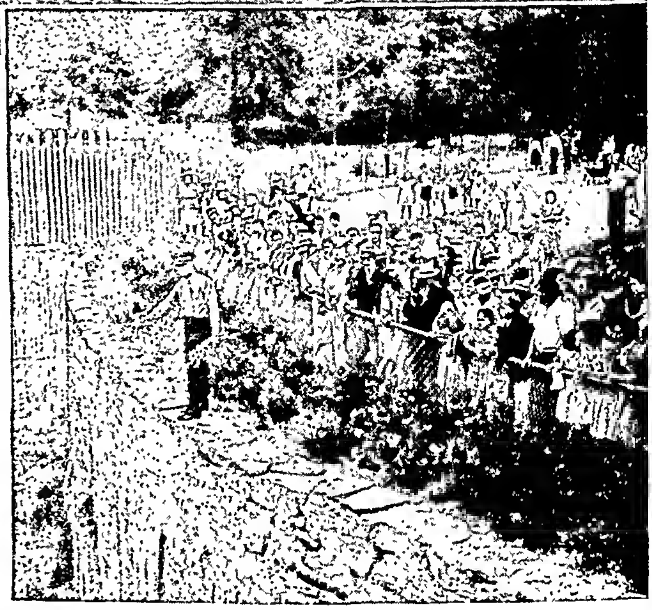
Birds are also displayed out of doors in natural settings. The zoorookery in Chicago's Lincoln Park Zoo is a fenced enclosure where birds live, nest, and raise their young. Their wings are clipped to prevent them from flying.

In San Diego, Calif., the zoo in Balboa Park has an enormous flight cage built over a steep ravine. The top of the cage is 20 feet above the peak of the hill; from the bottom of the ravine to the top of the cage is more than 100 feet. Tall eucalyptus trees, shrubs and flowers, two pools, and a running stream make a beautiful setting. In this wonderful retreat flamingos, herons, egrets, and many other birds live

"LIVING WILD" IN NEW YORK CITY



These lions seem to be living naturally on the plains of Africa. Actually they are in a Bronx Zoo exhibit in New York City. They remain on an island in the exhibit. Deep moats separate them from the visitors (right) and their animal neighbors. The keeper is throwing them some catnip. They love it just as much as house cats do.



safe from all enemies. In the spring the trees are filled with their nests and young. Another great cage in this zoo houses birds of prey. It is large enough to let eagles and hawks soar and hover on unclipped wings.

Modern Indoor Displays of Animals

All zoos still have cages, especially where the animals must be brought indoors for the winter. One modern example of displaying animals indoors is the great elephant house of the National Zoo in Washington, D.C. Visitors walk about in a darkened central space like the hall of a museum. Around the walls are brilliantly lighted "rooms" which hold the animals.

One room has giraffes in artificial African scenery. In another, a hippopotamus splashes in a pool bordered by a painted jungle. A Sumatran elephant tramps across a landscape painted with Buddhist temples. The African elephants have a jungle background. The rooms open outdoors into moated enclosures, where the animals wander in good weather.

The National Zoo also has a Nocturnal Room, where day is turned into night for the small creatures that are active only at night. The little kangaroo rat and Egyptian jerboa frisk about in artificial moonlight. They sleep at night in artificial sunshine.

Zoos for Children

Most zoos feature the strange animals of foreign lands. But in great cities many children and even some adults have never seen the common animals of the farms near by. Many have never owned a pet. To help these youngsters know about animals, some large zoos have special departments just for children.

New York City's Bronx Zoo has a "farm zoo." Children who have never left the crowded city can go on a hay ride for the first time in their lives. On the zoo farm they see cows being milked and sheep grazing with their lambs. The children find calves, chickens, and ducklings as marvelous as the lions and monkeys from faraway lands.

Another lively section of the great Bronx Zoo is the Children's Zoo. According to the rules, "no adult is admitted without a child." It is directed by a "zoo-perintendent." As the children enter the area they meet Deacon, the talking crow, who greets them with a scratchy but cheerful "Hallo! hallo!" They may ride the back of Kilroy, the llama, and cuddle Petunia, the fragrant skunk, in their arms. Petunia has had her scent glands removed and is one of the most popular pets in the zoo. Many animals are

chosen to illustrate the familiar nursery rhymes and stories—the tortoise and the hare, "baa-baa black sheep," and Br'er Rabbit. In a Noah's Ark are lovable and cuddly animals like the kinkajou, or honey bear, and various others. The animals are exhibited in relays during the day. Thus none of them becomes worn out with too much childish affection.

The Children's Zoo is closed in the winter. During this time the zoo-perintendent shows Petunia; Miss Tiggle-Wiggle, the hedgehog; and Jeffrey, the bantam rooster, in city schoolrooms and gives talks about them. The children also can pet them.

A new educational feature of the Bronx Zoo is its 12-acre conservation exhibit. It demonstrates soil erosion, erosion control, reforestation, stream control, and typical wild-life habitats.

The People Who Operate a Zoo

Few people realize how much hard work and planning are needed for even the smallest zoo. At the head of the zoo is the director. Under him are curators who have charge of different departments. There is a curator of birds, a curator of reptiles, and so on. Every large zoo has a hospital under the direction of a veterinarian. The animals are fed and their living quarters are cleaned by keepers.

Keepers are very important workers. The happiness and health of the animals depend largely on how well they like their keepers. In many cases there is deep affection between these men and their wild charges. Most zoos have greenhouses to grow plants for the grounds, and experts grow tropical plants for special indoor exhibits.

Every exhibit has labels that describe the animals. The labels are very carefully written by experts. First they give the popular and scientific name of the animal, where it came from, how long it usually lives, what it eats, anything unusual about its habits, how long the female carries her young before birth (the gestation period), and how many young are born at a time.

Zoos should be located near or in large cities where they can be reached by great numbers of visitors. For zoos are very expensive to operate and maintain, and the cities and their people must supply the necessary money. Most zoos are owned by city or county governments. Even private zoölogical societies receive government funds in addition to getting money through membership subscriptions, donations, and gate receipts. It costs more than a half million dollars a year to operate and maintain the National Zoo in Washington, D.C.

Are Animals Happy in the Zoo?

Nearly every child and adult enjoys the zoo. But how about the animals? Many people wonder if it is cruel to carry animals far from their homes and keep them confined behind bars and trenches where thousands of human beings stare at them.

It seems certain that animals are better off in zoos than they are living naturally. Wild animals are often hungry and sick. They may roam far and wide; but they do it to find food, not because they love the open spaces. They have many enemies and must often fight to protect themselves, their mates, and their young. Very few live to an old age.

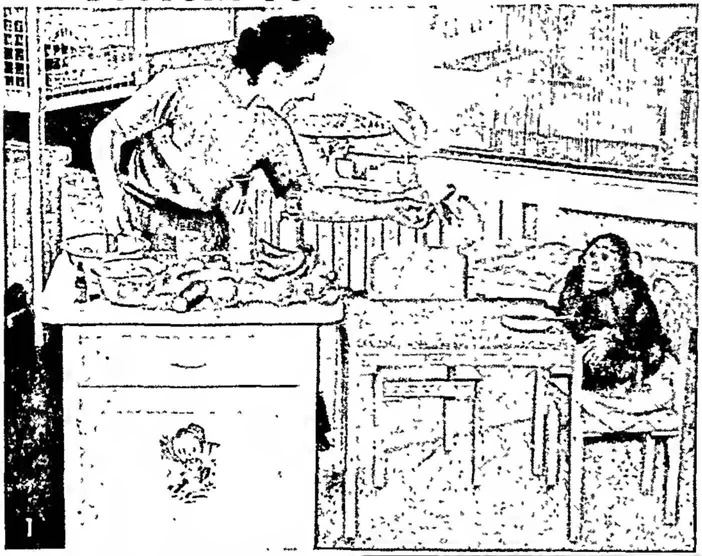
After a few weeks in a zoo, the good food, clean living quarters, and medical care usually produce a great improvement in the appearance of captive animals. Many of them mate and rear young in captivity. Many of them also seem to enjoy human visitors just as much as the visitors enjoy them.

Bears and seals love to show off. Monkeys and apes enjoy human companionship, especially

IN THIS ZOO CHILDREN CAN PLAY WITH ANIMALS

Many city children have never owned a pet or visited a farm. But New York City children can play with animals in a part of the Bronx Zoo called the Children's Zoo. Kilroy, the llama (left), lets children ride on its back. In Bantie Town (right) the zoo-perintendent tells a timid little boy not to be afraid of Petunia, the skunk.

DOCTORS FOR SICK ANIMALS



1. A keeper has delivered a sick chimpanzee to the zoo nursery and hospital. To make friends, the veterinarian's assistant offers the little ape a tasty banana.

that of their keepers. The Lincoln Park Zoo in Chicago once tried using one-way glass in the monkey house. People could look into the cages, but the monkeys could not see out. They became unhappy, and the glass was removed. At once the monkeys regained their lively spirits.

2. This chimpanzee is suffering from a toothache. It is helpfully showing the infected tooth to the doctor and its keeper, who brought it to the hospital for treatment.

Visitors often misunderstand certain animal actions as signs of unhappiness. Endless pacing back and forth is simply the animal's way of getting exercise. When brown bears stand for hours lifting one paw and then the other, they are following an instinct to pad down snow, even though they have no snow to pad. If a monkey gazes longingly into space, it is not grieving for a jungle home, which it cannot remember. It is probably waiting for a beloved keeper to appear with its food.

Many kinds of animals have a great need to feel secure. They want an area, however small, which is their own territory—a place where they can hide and feel safe. On the rare occasions when an animal escapes, it usually comes back to its own quarters after a few hours or days. It finds the outside world terrifying and circles back to the place where food and water will be waiting. Often the animals walk back through the open cage door of their own accord.

Giving Animals What They Like

Zoo directors go to endless trouble and expense to make their charges happy and keep them in perfect health. Each kind is given the "climate" to which it is accustomed. Penguins live in a great refrigerated room with an icy swimming pool. The Komodo dragon in the reptile house basks in a steamy glass-walled room where the temperature reaches 90° F. Filtered fresh air flows through the buildings because animals become irritable in stale, impure air. Apes are very likely to catch colds and other human diseases, and so they are separated from the public by plate glass.

Every animal is provided a sleeping place that resembles as closely as possible the type that it would naturally choose—a tree, a log, some brush or leaves in which it may hide. This sleeping place gives the animal needed privacy and concealment. In the raccoon cage is a fountain of bubbling water, because these animals are accustomed to washing their food in a running stream. The elephant may scratch its wrinkled hide against a great rough-surfaced pillar. The fox is provided with brushwood on which it may brush its glossy coat, just as it does in nature. The monkeys have bars, ropes, swings, and automobile tires for their play.

Animals may have their own pets. An elephant in the San Diego Zoo was devoted to a black Shetland pony who shared

3. Here a doctor gives a baby coyote vitamins and cod-liver oil with an eye dropper. In zoos, mother animals may not give their babies the best care or may even desert them. The veterinarian and keepers must take over the task of caring for them.

its living quarters. A monkey may make friends with a house cat. Many animals become very fond of their keepers. Monkeys and apes especially often do this, but so do other animals and birds. The San Diego Zoo had a sick baby walrus that fell asleep after each feeding with its head on its keeper's lap. The keeper always stayed until he could slip away without disturbing it.

In fact, the only enemies zoo animals have are wild animals from outside. Rats, weasels, hawks, crows, skunks, foxes, and squirrels may break into their living quarters to steal their food. Occasionally they attack the captives. Much greater harm is caused by human visitors. People throw all kinds of trash into the cages and outdoor enclosures and feed the animals things which make them sick. Some zoos have vending machines where people can buy proper food for feeding the animals.

Feeding Time at the Zoo

One of the hardest tasks in a zoo is that of providing healthful food. Many animals have unusual diets. A duckbill platypus wants 800 worms a day. The walrus likes soft-shelled clams; and the gila monster demands fresh eggs. The flamingo needs shredded shrimp to keep its plumage rosy in color. The giant panda wants bamboo shoots. The big python gets freshly killed poultry or other meat every other week. Monkeys and bears want variety. Lions and tigers refuse anything but raw meat. Vitamins, cod-liver oil, and minerals are added to many diets.

Trained workers prepare individual servings for each animal. In a large zoo, each major division has its own kitchen. Some zoos have their own slaughterhouse and kill aged horses to provide raw meat for the big cats. Most large zoos have their own bakeries. The Milwaukee Zoo bakes bread four or five times a week in batches of 72 loaves. Each loaf weighs about 14 pounds. Most of the bread is fed to the bears.

Baby animals born in captivity present special problems. If the mother dies or refuses to care for her young, the zoo must provide food by bottle or spoon. Like human babies, young mammals need special milk formulas. As they grow older they must be taught how to take solid food. A young sea lion gets a liquid mixture of finely ground fish, fish oil, salt, and iodine; but in time it must learn how to catch a whole fish flipped through the air.

A Visit to the Hospital

The zoo's veterinarian checks all animals periodically and discusses his observations with each keeper and with the director. Thus any illness is discovered early and given quick treatment. Sick animals are isolated in the hospital.

It takes considerable skill and experience to handle these resentful patients. A useful device is the "squeeze cage." Once the animal has been forced into the cage, it cannot move. Then it can be examined and given a hypodermic or anesthetic if necessary. Records are kept of all treatments and the results. Many zoos exchange this information for future use. If an animal dies, an autopsy determines the cause of death. A big zoo like the Bronx maintains a busy laboratory where technicians make a scientific study of animal diseases.

All new arrivals must remain in quarantine in the hospital until they are proved to be free from disease. They can also rest and get adjusted to their new surroundings. Their cages are small for a good reason. After a long voyage the animals are nervous. In large cages they might rush at the bars and injure themselves.

How Zoos Get Their Animals

New animals are obtained from four sources of supply. The first and by far the most important is the animal dealer. Before the second World War, Hagenbeck and

THE ALL-TIME FAVORITE OF ZOO VISITORS

Three million people came every year to see Bushman, the gorilla in Chicago's Lincoln Park Zoo. Probably this is a record for zoo exhibits. On his 19th birthday, Bushman got a cake made of two loaves of rye bread filled with fruit salad. On top it had 19 stalks of celery. At that time Bushman weighed 525 pounds, and he was six feet, two inches tall. He died on New Year's Day 1951, when he was almost 23 years old.

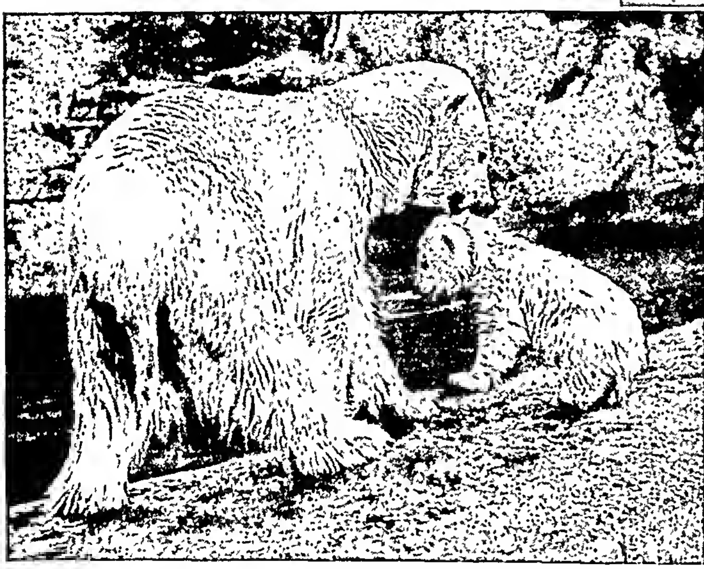
Sons were the most famous of the animal dealers. Their holding farm was the Tiergarten in Hamburg, Germany. Another well-known firm is the Ruhe family, originally of Hanover, Germany. They have a large holding station at Flushing, Long Island. There they keep imports, sent to them by their agents throughout the world.

Representatives of the zoos come to look over the animals they wish to buy. The animal quarters are barns with big box stalls. Many of the barns open out into yards or runways where the animals may have outdoor exercise.

Some dealers send their own expeditions into the jungles, mountains, and deserts around the world. More often their agents buy animals from natives who do the dangerous work of trapping. Wild animals do better in zoos if they are captured young. They adapt themselves more readily to captivity and are more easily handled.

The second most important source of animals is *trading with other zoos.* A *zoo often has a surplus* of animals on hand due to births. Zoos keep in touch with one another and offer excess stock in trade for animals they do not possess.

PEOPLE LIKE ZOO MOTHERS AND BABIES



A mother animal and her young always draw crowds at a zoo. The upper picture shows a Bactrian camel and her long-legged child. In the picture at the left, a polar bear drags her cub from a pool.

A third but rare source of new animals is expeditions organized by zoos. Zoos do this only to get rarities not usually handled by dealers. The San Diego Zoo once sent an expedition to the Guadeloupe Islands for fur seals. In 1928 the New York Bronx Zoo sent its curator of birds to the wild mountains of New Guinea for birds of paradise. An expedition led by the director of the National Zoölogical Park, Washington, D. C., and sponsored by the National Geographic Society and the Smithsonian Institution, once brought back alive nearly 900 animals, birds, and reptiles. The fourth and least important source is gifts from individuals.

All imported animals are subject to quarantine regulations of the United States Department of Agriculture. This is necessary to protect domestic animals from infectious diseases.

Prices for Wild Animals

Prices vary widely and depend on age, sex, size, health, and rarity. A ten-foot giraffe (the usual size imported) is obviously expensive because it cannot be carried in a railroad car. Landed in the United States, it is worth about $4,000. The cost of transporting a hippopotamus from the Sudan in Africa to Kansas City or Los Angeles is enormous. Some rare and delicate specimens probably would not survive a long ocean voyage, and so they must be shipped by air.

Probably the most valuable of all zoo animals was Bushman, a gorilla owned by Chicago's Lincoln Park Zoo. He was captured in French West Africa as a baby in 1929 and was sold to the zoo the following year for $3,500. In 1947, when he was in the prime of life, he was valued at $100,000. He died in 1951 of heart disease.

Among other rare and valuable animals are the okapi ($10,000 to $15,000), the bongo ($20,000), the Indian rhinoceros ($12,000), and the Siberian tiger ($8,000). Lions are among the cheapest of animals because they breed readily in captivity and most zoos have a surplus. They can be bought for as little as $100. (*See also* Monkeys.)

Snakes are often purchased by length. A Florida animal dealer advertises a fixed scale of prices for

rattlesnakes brought in by snake hunters: $1.50 for three feet, $3 for four feet, $5 for five feet, $10 for six feet, $25 for seven feet, and a standing offer of $200 for an eight-foot rattlesnake. No one has yet claimed the $200 price. Pythons are sold at $5 to $10 for each of the first six feet. The price skyrockets, as it does with rattlesnakes, when an unusually long reptile is available.

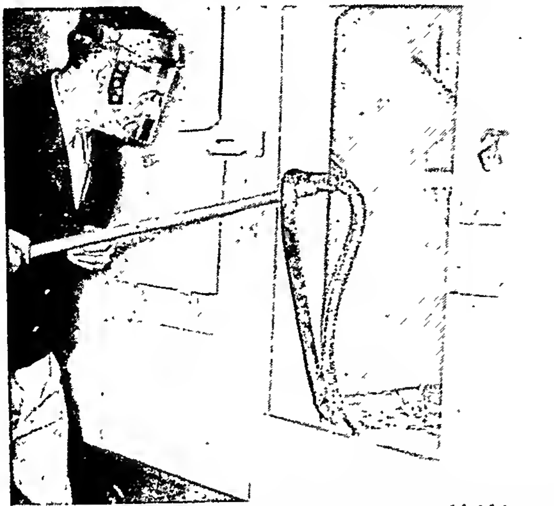
Rarities Seldom Found in Zoos

Some animals are rare because they live in out-of-the-way places and special expeditions must be sent to get them. Others are on the verge of extinction and are protected by law. The koala, a gentle little creature found only in Australia, is becoming very rare and does not thrive in captivity. Export is now forbidden. China no longer permits the export of the giant panda from its home in the lofty highlands of central Asia. A specimen obtained by the Brookfield Zoo, near Chicago, in 1937, was the first one ever exhibited in a zoo, although it has been known to science since 1868. Like the koala, the panda does not live long in captivity.

Certain animals are almost impossible to feed in captivity. Among them are the anteater and the duck-bill platypus, for example. Other rarities are the echidna; the proboscis monkey of Borneo; the spectacled bear of the Peruvian Andes; the pangolin or scaly anteater; the hyrax of Africa, Arabia, and Syria; and the kiwi, a curious New Zealand bird.

Some animals, like the moose, are common enough in the wild state but do not live well in captivity. Hoofed animals from regions where certain communicable diseases occur, such as the hoof and mouth disease and rinderpest, are subject to exacting requirements to protect domestic animals from infection. They must be isolated for 60 days at the point of embarkation and proved free of disease.

KEEPERS NEED MANY SKILLS



This keeper is moving a cobra. He wears a shield to protect his eyes in case the snake spits venom. Keepers have special ways for handling each dangerous animal.

Here a fox is to be sent to another zoo. But it objects to being placed in a shipping crate. The keeper must use patience and skill to keep from being bitten.

Feeding the animals is an important daily duty. Here a keeper gives a lioness a piece of raw meat. The big cats get meat six days a week and fast on the seventh day.

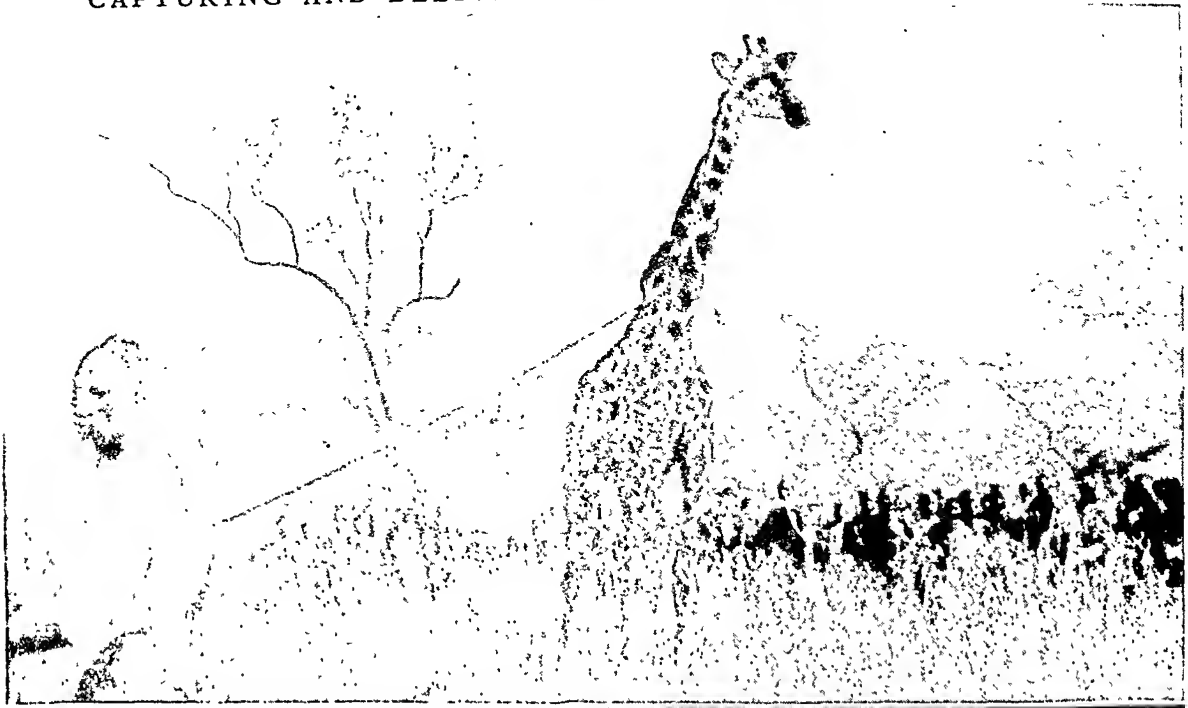
History of Zoos

The first zoo of which we have any record was founded in 1100 B.C. by the Chinese emperor Wu Wang. Its name, "Intelligence Park," indicates that the animals were kept for an educational or scientific purpose. The ancient Greeks and Romans made collections of wild beasts, mostly for gladiatorial combats. During the Middle Ages, princes and feudal chieftains kept menageries and aviaries. Some of the Aztec rulers of Mexico in the 15th and 16th centuries maintained collections of wild animals, as did also the Incas of Peru.

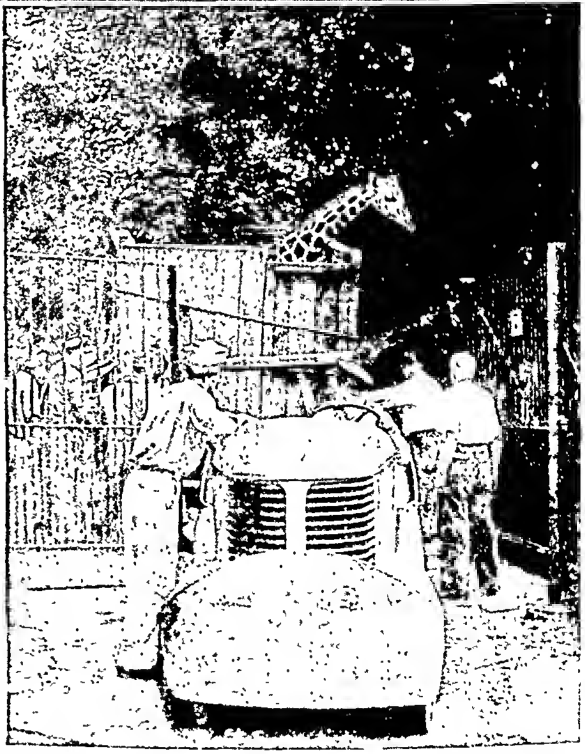
The famous zoo of the Zoölogical Society of London in Regent's Park was founded in 1826. It is noted for possessing one of the most comprehensive exhibits of birds, beasts, and reptiles in existence. The London zoo led in devising many modern methods such as the use of artificial sunlight, radiant heat, and windows of vitaglass to admit ultraviolet light.

Excellent zoölogical gardens have been maintained in Antwerp, Rotterdam, Amsterdam, Berlin, Hamburg, Hanover, Frankfort-on-the-Main, Cologne, Paris, Rome, Vienna, Copenhagen, Lyons, Marseilles, and several other European cities.

CAPTURING AND DELIVERING THE TALLEST OF ANIMALS



In the picture above, African hunters on horseback have lassoed a fully grown giraffe. His head stands from 18 to 19 feet above the ground, so of course he cannot travel in any railroad train. He must be carried in open-top carts or trucks and in a high space when he travels by ship. Finally he is delivered to some zoo (right).



Australia has zoölogical parks at Melbourne, Sydney, Adelaide, and Perth. Good collections are also displayed in Tokyo, Buenos Aires, Rio de Janeiro, Lima, at Alipore, near Calcutta, in Bombay, India, and in Rangoon, Burma. Canada has fine collections in Quebec, Toronto, Vancouver, Calgary, and some other cities.

In the United States, the Philadelphia Zoo, opened in 1874, is the oldest to which a definite date may be given. Chicago's Lincoln Park Zoo started informally with a gift of two swans to the city park in 1869. By 1873, when the Lincoln Park Commission was created, gifts had enlarged the collection to 15 kinds of animals, and during the 1870's new buildings were erected to house them.

The New York Zoölogical Garden in Bronx Park, opened in 1899, is one of the largest in the world. It covers about 250 acres. Among its 2,500 animals are the only bongo, okapi, and duckbill platypus in captivity. The National Zoölogical Park at Washington, D.C., is under the direction of the Smithsonian Institution. Its splendid site with about 175 acres provides approximately natural living conditions for nearly 3,000 animals. The zoo was founded in 1889. The Lincoln Park, Bronx, and National zoos are rivals for the largest annual attendance. Each one has 3 to 4 million visitors. Lincoln Park, located in the heart of a great city, entertains more than 100,000 people on a pleasant summer Sunday.

The St. Louis, Mo., zoo, in Forest Park, founded in 1916, is noted for its fine performing animals. The San Diego, Calif., zoo is famous for its successful breeding of animals. The Philadelphia Zoo was the first to breed the second generation of orangutans. Brookfield Zoo, near Chicago, and the Detroit Zoo, have perhaps the most completely moated zoos in the world. Each zoo has some outstanding feature and it is impossible to say that any one is the best.

ZOOLOGY—*The Study of* LIFE *in* ANIMALS

ZOOLOGY. Animal life, from the amoeba up to man, is the subject matter of zoology. (In this encyclopedia, the lives and habits of animals are explained in the article Nature Study. Bodily structures and vital processes are explained in the articles on Animals and Life.)

Until the last three centuries, zoologists studied principally the external appearances of animals, such as shape, color, and differences in teeth, limbs, and horns. Today they are more concerned with the animal's internal structure, its vital processes, and its place in the scheme of nature, both past and present. Through such investigations, zoology becomes closely linked with botany. These two sciences comprise the main divisions of biology, "the science of physical life" (*see* Biology).

Subdivisions of Zoology

Most zoologists specialize in one or more subdivisions of the science, such as the structure of animals (*morphology*), their development before being hatched or born (*embryology*), or their vital activities (*physiology*). Other subdivisions are based upon the type of animal studied. The study of fish, for example, is called *ichthyology* (from a Greek word for "fish"). Other subdivisions of this sort are: the study of insects (*entomology*); of reptiles (*herpetology*); and of birds (*ornithology*).

Specialists in these subjects contribute greatly to maintaining the world's supply of food animals. Ichthyologists, for example, devise measures for conserving species of food fish which are threatened with extinction by overfishing, changes in the natural food supply, or the appearance of new natural enemies. Introduction of a new food plant often depends for success upon the ability of entomologists to suppress or check insect enemies.

The study of heredity in animals is linked with parallel studies of plants in the science of *genetics*. Such studies of heredity in animals are allied with the work of animal breeders. The zoologist seeks to enlarge the knowledge of heredity as a biological process. The breeder applies such knowledge and his own experience to the production of new, useful types of animals, particularly livestock.

The geographical distribution of animals has been widely studied and now ranks as a special department. Many naturalists divide the world into six great zoogeographical regions, or life realms:

1. Palearctic Region: Includes Europe, Asia north of the Himalayas, and Africa north of the Sahara.
2. Nearctic Region: North America north of Mexico.
3. Ethiopian Region: Africa from the Sahara southward and Madagascar.
4. Oriental Region: India, Ceylon, Thailand (Siam), southern China, and the Malay Archipelago.
5. Neotropical Region: America from Mexico southward.
6. Australian Region: Australia, Tasmania, New Guinea, New Zealand, Pacific Islands.

An extremely important division of zoology is the task of classifying animals (*taxonomy*) according to natural relationships. Since the relationships include possible common ancestry, or descent of one type from another, the classification results in a "family tree" of animals, as nearly as this can be achieved. The article Animals gives a diagram of such a tree and explains the principal features used in classifying animals.

The Men Who Built the Science of Zoology

The Greek philosopher Aristotle has been called the "father of natural history," which includes zoology. He was a man of truly scientific mind and made many original observations on the structure and development of animal life. The Roman Pliny the Elder also wrote on zoology; but he was less scientific, mixing borrowed facts, fancy, and fabulous stories with his own observations.

In the 16th century, Vesalius revived the science of human anatomy (*see* Anatomy). This kindled interest in all animal structure, and scientific investigation spread gradually downward from higher to lower forms. Jan Swammerdam advanced the science by his dissections and life history studies. The development of the microscope, from the 17th century on, made it possible to observe minute animal forms and structures.

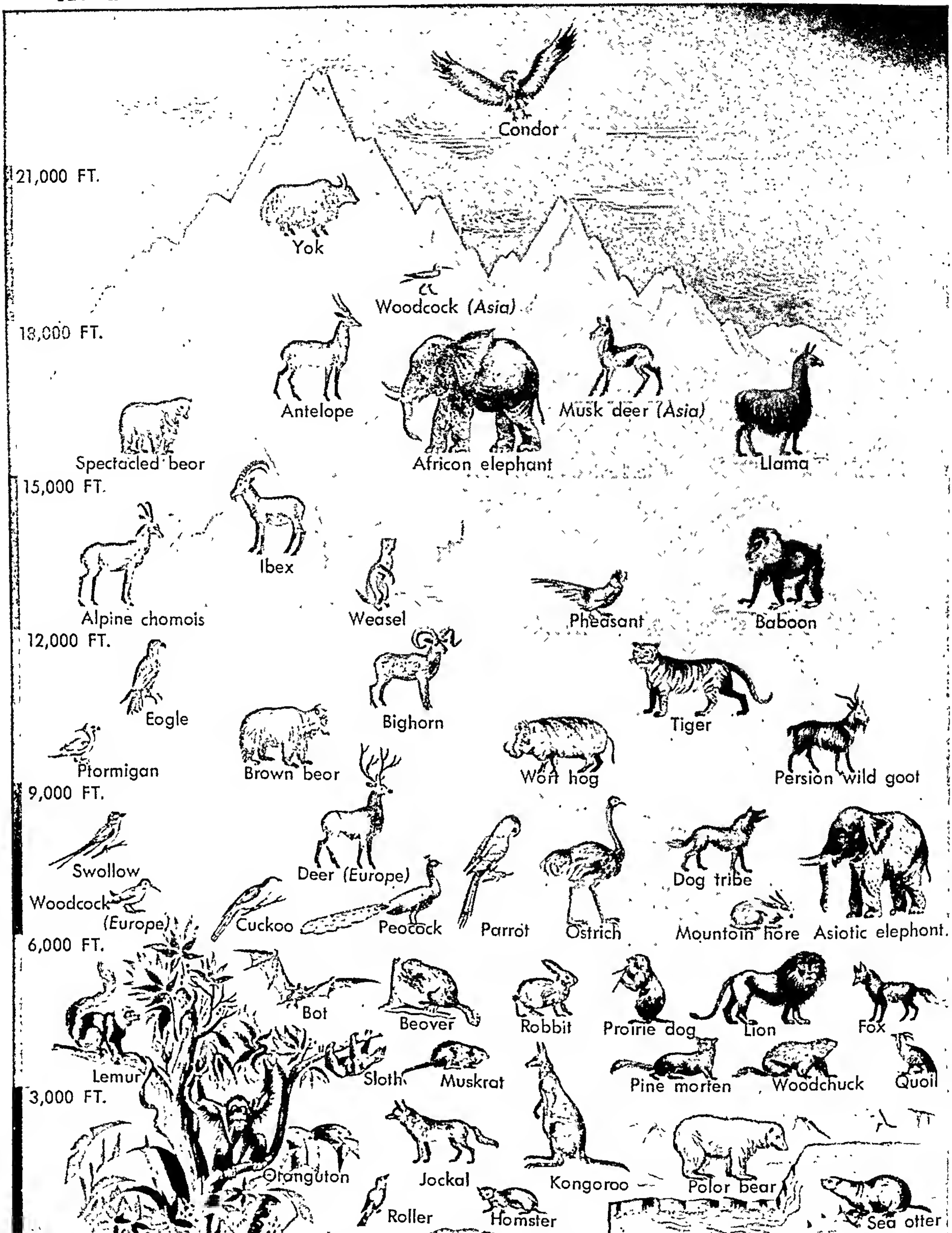
The systematic classification of animals (as well as plants) owes much to the Swedish naturalist Carl von Linné (*see* Linné). The French zoologist Comte de Buffon was a man of more philosophical mind than Linné. He created a popular interest in the subject by his graceful writings, opened up new fields, and led the way in some matters of great importance. His countryman Georges Cuvier laid the foundation of the comparative study of the structure of animals (comparative morphology).

Another French scientist, Chevalier de Lamarck, was the most noteworthy of the predecessors of Charles Darwin in the study of evolution. Microscopic study of animal tissues by Theodor Schwann founded the science of histology and led to the establishment of the cell theory (*see* Cell). The study of embryology, or the development of the individual organism, was founded by Karl Ernst von Baer. At the same time Johannes Müller laid the foundations of animal physiology.

After 1860, the science was given new direction and a new guiding light by the doctrine of organic evolution, as set forth by Darwin in 1859 (*see* Darwin; Evolution). From that time to the present the study of zoology has been guided by the idea of evolution, and animals have been studied in the light of their ancestral history. August Weisman furthered such studies by discovering some of the processes whereby germ cells pass on hereditary characteristics (*see* Heredity).

In the 20th century, zoologists learned how to induce changes in the heredity of many creatures by

ALTITUDE RECORDS IN THE ANIMAL WORLD



Some animals are found only near sea level, others never leave their mountain homes. Among large animals the yak of the lofty Tibet plateau holds the record for altitude—because the condor, though it flies above the highest peaks of the Andes, nests much lower down. It may surprise you to see the African elephant and the baboon so high up in the world; but remember it is warmer at these heights in equatorial Africa than it is on the frozen shores where the polar bear makes its home. The cat family as a rule flourishes best in lowlands, but the Siberian tiger, protected by long soft fur, ranges as high as 10,000 feet among the highlands of central Asia.

applying chemicals, X rays, or other stimuli to germ cells. Discovery of hormones and vitamins added enormously to understanding of the physicochemical processes which support life. The techniques of microdissection, using needles under microscopes, and microanalysis of tiny samples have enabled scientists to study the contents of single cells. Today zoologists are no longer limited largely to observation and dissection as their principal means of gaining knowledge. In their studies of animal life, they make increasing use of exact experimental procedures under the controlled conditions of the laboratory.

REFERENCE-OUTLINE FOR STUDY OF ZOOLOGY

Note: Material on the life habits of animals and adaptations of their body structure is listed in the Reference-Outline for Nature Study. Physical and chemical aspects of animal life processes are given in the Reference-Outline for Biology. This Outline covers zoology as a science, the relations between animals and mankind, and the scientific classification of animals.

I. Zoology—the science of animal life Z-361
- A. Subdivisions Z-361: anatomy (morphology) A-239; cells as basic life units (cytology) L-224*a*, *b*, c, C-159-61; development of young (embryology) E-337-8; life processes (physiology P-238; animals of past ages (paleontology) B-151
- B. Special methods and aids: biochemistry B-145-7; microscope M-232-6; observation in aquariums, zoos, and other collections A-279-82, Z-353-60, N-64-7

II. Life zones and habitats Z-361
- A. North American zones N-258-63
- B. Interrelations among animals, plants, and environment: ecology E-213-222

III. Evolution and heredity E-450-3, H-343-8
- A. Changes through the ages G-57-60, P-406-7, F-243-8: extinct mammals M-62, S-1-2, pictures M-61; the age of reptiles R-111-16
- B. Shifts between sea and land living A-248, 250: air-breathing fish F-100, 107; amphibians S-25-6, G-59; reptiles R-112; whales W-111
- C. Methods of reproduction A-251. See also Reproduction in Fact-Index

IV. How the science of zoology grew Z-361

IMPORTANCE OF ANIMALS TO MAN

Note: For material on protection and preservation of animal wildlife, see the Reference-Outline for Conservation.

I. Useful substances obtained from animals
- A. Wild animals taken for food: deer D-43; antelope A-262; rabbit and hare R-15; pheasant P-187; quail Q-1; duck D-158; frog F-299; food fishes F-108; snail S-204; scallop S-54; clam and mussel C-338; crab C-503; lobster L-286; shrimp S-168; sea cucumber S-86

  Note: Domesticated animals used for food are treated in the Reference-Outline for Agriculture.
- B. Food products from animals: gelatin G-35; honey B-96; lard and tallow F-44-5; meat M-153-6*b*; milk and dairy products M-250-3, D-2-5, C-206-7
- C. Commercial products from animals P-149: alpaca A-176; ambergris W-114; beeswax B-96; bone B-226; bristles H-243; cochineal C-373, I-150: coral C-476; feathers F-46, O-426*b*; fertilizers F-55; furs F-321; glue G-127; glycerin G-127: horn H-426; isinglass G-35; ivory I-283; leather L-147; mohair G-129; mother-of-pearl S-139*a*; musk M-472, C-515; parchment B-232; pearl P-107; sepia I-150; shell S-138; shellac L-82; silk S-181; spermaceti W-114; sponges S-353; Tyrian purple D-165; wool W-192

II. Animals used for transportation and work: ass A-424; water buffalo B-341; camel C-50; dog D-110; elephant E-324; horse and mule H-428-9; llama L-285; ox C-141; reindeer R-97; yak Y-333; zebu Z-350

III. Animals that help in nature
- A. Destroyers of pests: badger B-15-16; bat B-77; mole M-332; skunk S-193; birds, general B-157-8; hawk H-291; owl O-430; frog F-300; toad T-140; snake S-208; insects I-153; calosoma beetle, picture B-104; dragonfly D-126; ichneumon fly I-12; ladybug L-84, S-53; wasp W-53
- B. Plant pollenizers I-153, C-359: bee B-96-9; hummingbird H-444
- C. Scavengers: insects B-106; gulls and terns G-230; buzzard, condor, and vulture B-372, C-431*b*, V-524; hyena H-460
- D. Soil tillers and land builders: earthworm E-197-8; coral C-476-8; foraminifera P-423

IV. Animals that injure men directly
- A. Disease parasites: protozoans P-423, table D-102; Asiatic liver fluke W-302; hookworm H-419, W-303; malaria parasite M-401-3; tapeworm W-302; trichina parasite W-303
- B. Disease carriers: flea B-203, F-142; fly F-188; louse P-77-8, pictures P-79; mosquito M-400-404, P-56, G-142-3, R-89; tick S-348; tsetse fly T-202
- C. Annoying pests: chigoe (chigger), picture P-78; body lice, pictures I-154*b*, P-79
- D. Poisonous animals: Gila monster L-283; snakes S-206-8, C-372-3, C-475, M-328, R-77-8, V-476-7; spiders S-342

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- B. Livestock and poultry: fox F-253; lynx L-355; puma P-435; weasel W-77; wolf W-180; hawk H-291; botfly F-189; mite and tick S-348; liver fluke W-302; other internal parasites P-77
- C. Stored food: cockroach C-373; house ant A-257; mouse M-441; rat R-76; weevil W-85
- D. Clothing and books: bookworm B-107; carpet beetle B-107; clothes moth B-368; drugstore beetle B-106
- E. Houses, ships, and wharves: barnacle B-56; "death-watch" beetle B-107; termite T-74; teredo T-73

SCIENTIFIC CLASSIFICATION OF ANIMALS

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II. Principles of classification A-251-2, B-152
   A. Features of the largest groupings A-252
   B. Scientific names B-152

Note: In the following classification, only the two most important phyla, the Arthropoda and the Chordata, are subdivided further into classes and in some instances into orders. In the listings which follow immediately, each phylum is indicated by boldface type, thus: **Protozoa.**

Invertebrates (except Arthropoda)

Phylum **Protozoa** (single-celled, water-dwelling, or parasitic animals) P-423, A-252: amoeba A-236*b*, L-224-224*a*; foraminifera C-182; malarial parasite M-401-2; paramecium (slipper animalcule) P-423; radiolaria, color pictures G-124; trypanosome, picture D-102

Parifera ("pore-bearer" animals): sponges S-353-5

Coelenterata (polyps, the "hollow-gut," or sacklike, animals): coral C-476; hydra H-455-6; jellyfish J-333-4; sea anemone S-85-6

Ctenophora ("comb-bearing" animals): transparent marine animals of various shapes; swim by waving cilia arranged in eight combs along the body

Platyhelminthes (flatworms) W-302

Nemertea ("proboscis worms," or ribbon worms) W-302

Rotatoria (rotifers, or "wheel animalcules"): microscopic marine types; wheel of cilia at mouth end of body beats to capture food and for moving

Nematoda (roundworms) W-303: hookworm H-419

Chaetognatha ("bristle-jawed" arrow worms), picture W-303, table W-303

Bryozoa ("moss" animals): new animals bud from old, remaining united in masses that resemble plants

Brachiopoda ("arm-foot" animals, the lampshells): tentaclelike appendages coiled inside two-valved shell shaped like Roman lamp; live fastened to rock by stem through lower valve of shell

Echinodermata ("spiny-skinned" animals, with body parts arranged in starlike pattern): starfish and sea urchins S-382-3, S-94; sea cucumbers S-86

Annelida (annelid worms with ringlike segments) W-304, pictures W-303: earthworm E-197-8; leech L-157-8, picture W-302

Onychophora ("claw-supported" animals): small, caterpillar-shaped creatures with stubby, clawed feet; live under rotting wood in tropical forests

Mallusca (mollusks) M-333-4: shells S-138-41; clams and mussels C-338-9; nautilus N-69; octopus, cuttlefish, and squids O-337-9, S-359; oysters O-436-40, P-107; scallops S-54-5; snails and slugs S-203-4

Phylum Arthropoda

"Jointed-leg" animals; skin stiffened with chitin or lime to serve as outside skeleton

Note: This phylum is subdivided into classes, indicated with boldface type, thus: **Chilopoda.**

Class **Chilopoda** ("jaw-footed" animals, so-called because first pair of legs serve as poison fangs): centipede C-171

Diplopoda ("double-footed" animals, so-called because many body segments have two pairs of legs): millipede C-171

Crustacea ("crusty shells," usually ten-legged): barnacle B-56; crab C-503-5, pictures C-505; crawfish C-507-8; lobster L-286-8; shrimp S-168

Arachnida (eight-legged "spinners") S-342, 348: scorpions S-61; spiders, mites, and ticks S-342-8; horseshoe (king) crab T-189, picture C-504

Insecta (six-legged arthropods) I-152-160*a*: important orders, list I-160*a*. See also Insects in Fact-Index, and articles on important species

Phylum Chordata

"Spinal-cord" animals. Primitive forms have the cord supported by a gristly rod, the notochord. Higher forms (the vertebrates) have a jointed backbone and internal skeleton.

Note: This phylum is subdivided into classes, indicated by boldface type, thus: **Cyclostomata.** A few classes are subdivided into orders, also indicated by boldface type.

Class **Cyclostomata** ("circle mouths," or suckers): lamprey and hagfish L-88, picture P-78, F-100

Pisces (fishes) F-99-100, 107. Four groups are recognized, according to development of skeleton, skin, and breathing:

Cartilaginous skeletons (selachians) F-99-100, 107: sharks S-134-5, picture F-104; skates and rays S-190, picture F-103; torpedo fish T-155-6

Lungfishes (can breathe out of water) F-100, 107: mudfish M-443-5

Armored skin (ganoids) F-100, 107: sturgeon S-434

Bony fish (teleosts) F-100, 107. Includes most of the species alive today. For additional information, see Fish in Fact-Index, and individual species by name

Amphibia ("doubtful" animals, so-called by ancients because young live in water like fishes, adults on land like reptiles): frog F-299-301, pictures F-298; salamander S-25-6; toad T-140-1

Reptilia: reptiles R-110-11. Four living orders:

Order **Chelonia:** turtles, tortoises T-222-4, T-158

Order **Squamata:** lizards L-281-4, I-25, C-183; snakes S-205-9, B-212, C-372, C-475, M-328, P-448, R-77-8, V-476-7

Order **Crocodilia:** alligators A-171; crocodiles C-514*b*-515 (gavials C-515)

Order **Rhyncocephalia:** tuatara R-111, picture R-110

Extinct orders of the age of reptiles: R-111-16

Aves: birds B-156-96. The principal orders of American birds are given on page B-178, with examples of each order. For additional information, see Birds in Fact-Index and individual species by name

Mammalia: mammals M-60-2. Of the 15 orders of mammals, two include animals which do not give birth to completely formed young. These orders are:

Order **Monotremata** (egg-laying mammals) M-62: duckbill (platypus) D-162; spiny anteater A-261

Order **Marsupialia** (marsupials, with abdominal pouch for carrying young) M-62: kangaroo K-1-2; opossum O-399; Tasmanian devil T-22; Tasmanian wolf T-22, picture T-21

All other mammals are called "placental," from the structure which holds unborn young until fully formed. They are divided into 13 orders, according to bodily form and life habits. Examples are: **Insectivora** (insect eaters); **Carnivora** (flesh eaters); **Perissodactyla** (hoofed animals with odd number of toes); **Artiodactyla** (hoofed animals with even number of toes).

The orders are listed, with important examples of each, on page M-62. The concluding order is **Primates** ("chiefs"), which includes animals with hands and fingers equipped with nails. Included in it are lemurs, monkeys, apes, and man.

BIBLIOGRAPHY FOR ZOOLOGY

Books for Younger Readers

Beebe, William. Exploring with Beebe (Putnam, 1932).
Bronson, W. S. Coyotes (Harcourt, 1946).
Bronson, W. S. Horns and Antlers (Harcourt, 1942).
Bronson, W. S. Wonder World of Ants (Harcourt, 1937).
Fabell, W. C. Nature Was First! (McKay, 1952).
Franklin, G. C. Wild Animals of the Southwest (Houghton, 1950).
Gall, A. C. and Crew, F. H. Wagtail (Oxford, 1937).
Hausman, L. A. Beginner's Guide to Fresh-Water Life (Putnam, 1950).
Hausman, L. A. Beginner's Guide to Seashore Life (Putnam, 1949).
Hausman, L. A. Field Book of Eastern Birds (Putnam, 1946).
Hagner, D. C. Farm Animals (Oxford, 1945).
Humphreys, Dena. Zoo Book (Holt, 1947).
Huntington, H. E. Let's Go to the Brook (Doubleday, 1952).
McCracken, Harold. Biggest Bear on Earth (Lippincott, 1943).
McCracken, Harold. Sentinel of the Snow Peaks (Lippincott, 1945).
Mason, G. F. Animal Tracks; Animal Homes; Animal Tools (Morrow, 1943–51).
Mellen, I. M. Wonder World of Fishes (Dodd, 1951).
Mae, Virginia. Animal Inn (Houghton, 1946).
Morgan, Alfred. Aquarium Book for Boys and Girls (Scribner, 1936).
Morris, P. A. Boy's Book of Snakes (Ronald, 1948).
Patch, E. M. and Fenton, C. L. Forest Neighbors (Macmillan, 1952).
Tibbets, A. B. First Book of Bees (Watts, 1952).
Verrill, A. H. Shell Collector's Handbook (Putnam, 1950).
Webb, Addison. Birds in Their Homes (Garden City, 1947).
Williamson, Margaret. First Book of Birds (Watts, 1951).
Williamson, Margaret. First Book of Bugs (Watts, 1949).
Zim, H. S. Elephants; Frogs and Toads; Goldfish; Great Whales; Rabbits; Snakes; What's Inside of Animals? (Morrow, 1946–53).
Zim, H. S. and Gabrielson, I. N. Birds (Simon & Schuster, 1949).

Books for Advanced Students and Teachers

Abbott, R. T. American Seashells (Van Nostrand, 1954).
Anthony, H. E. Field Book of North American Mammals (Putnam, 1928).
Beebe, William, ed. Book of Naturalists (Knopf, 1944).
Breder, C. M. Field Book of Marine Fishes of the Atlantic Coast from Labrador to Texas (Putnam, 1929).
Buchsbaum, R. M. Animals without Backbones (Univ. of Chicago Press, 1948).
Burton, Maurice. Story of Animal Life, 2v. (Bentley, 1951).
Cahalane, V. H. Mammals of North America (Macmillan, 1953).
Cansdale, G. S. Animals and Man (Praeger, 1953).
Carrighar, Sally. One Day at Teton Marsh (Knopf, 1947).
Carrighar, Sally. One Day on Beetle Rock (Knopf, 1944)
Carter, T. D. and others. Mammals of the Pacific World (Macmillan, 1945).
Comstock, J. H. Spider Book (Comstock, 1948).
Devoe, Alan. This Fascinating Animal World (McGraw, 1951).
Franklin, G. C. Wild Animals of the Five Rivers Country (Houghton, 1947).
Guyer, M. F. Animal Biology (Harper, 1948).
Harpster, H. T. Insect World (Viking, 1947).
Hegner, R. W. College-Zoology (Macmillan, 1951).
Hegner, R. W. and Jane. Parade of the Animal Kingdom (Macmillan, 1953).
Holland, W. J. Butterfly Book (Doubleday, 1931).
Hornaday, W T. American Natural History (Scribner, 1935).
Lutz, F. E. Field Book of Insects (Putnam, 1935).
Morgan, A. H. Field Book of Animals in Winter (Putnam, 1939).
Morgan, A. H. Field Book of Ponds and Streams (Putnam, 1930).
Morris, P. A. A Field Guide to the Shells of Our Atlantic and Gulf Coasts (Houghton, 1951).
Newman, H. H. Outlines of General Zoology (Macmillan, 1943).
Peterson, R. T. Field Guide to the Birds (Houghton, 1947).
Peterson, R. T. Field Guide to Western Birds (Houghton, 1941).
Peterson, R. T. Wildlife in Color (Houghton, 1951).
Pope, C. H. Snakes Alive and How They Live (Viking, 1937).
Pope, C. H. Turtles of the United States and Canada (Knopf, 1939).
Pray, L. L. Taxidermy (Macmillan, 1943).
Sanderson, I. T. Animal Tales (Knopf, 1946).
Sanderson, I. T. How to Know the American Mammals (Little, 1951).
Shull, A. F. and others. Principles of Animal Biology (McGraw, 1946).
Smith, H. M. Handbook of Lizards (Comstock, 1946).
Storer, J. H. Web of Life (Devin-Adair, 1953).
Teale, E. W. Exploring the Insect World (Grosset, 1953).
Thomson, J. A. New Natural History, 3v. (Putnam, 1926).
Williams, J. H. Elephant Bill (Doubleday, 1950).
Wood, L. N. Raymond L. Ditmars (Messner, 1944).
Wright, A. A. and A. H. Handbook of Frogs and Toads (Comstock, 1949).

(*See also* bibliographies for Animals; Birds; Insects; Nature Study.)

ZOROASTER. One of the most ancient religions still practiced today is Zoroastrianism. It was founded by Zoroaster (also called Zarathustra, or Zarathushtra), a wise man of ancient Iran. Nothing is known for certain about Zoroaster himself, except that he probably lived about the 6th century B.C. What are believed to be his own words are included in the Gathas, the oldest writings of this religion. The language of the Gathas has given scholars the clue to Zoroaster's own time.

Zoroastrianism was perhaps the first universal religion, as opposed to the purely national or tribal faiths of the Egyptians and the ancient Jews. From the start it aimed at converting men of all nations and tribes, and thus it became the first creed to work by missions. Followers of Zoroastrianism grew until the Persian Empire was at its height (*see* Persian History). At that time most of the people of western Asia and Asia Minor practiced this faith. Today there are only about 130,000 left.

Zoroaster preached that the Supreme Being was *Ahura Mazda*, meaning "Lord of Life and Creator of Matter." Derived from Ahura Mazda was *Asha*, the law of God, of righteousness and spiritual purity. The Sacred Fire symbolized this law. *Vohu Mano*, the principle of spiritual love, ranked close to Asha. These two concepts were rounded out by *Kshathra*, or loving service to one's fellow man. Zoroaster taught that the existence of evil (*Ahriman*) is necessary and that men can only achieve the good life by fighting a constant battle against evil. The greatest gift of Ahura Mazda, said Zoroaster, is intelligence; with it men have the power to choose between good and evil. Men know the hardship in living the good life; but they also know the consequences of evil.

Fire, symbol of the spirit, played an important part in Zoroastrian ritual. But followers of the pure religion were not actually Fire Worshipers, as they have sometimes been called. Their doctrines and teachings as embodied in their later sacred

book called the Avesta or Zend-Avesta, show that their ideal of religious and moral life was a high one. It is summed up in the words, "good thoughts, good words, good deeds."

The *magi* were the priestly and learned caste of the ancient Persians. Zoroaster laid down rigorous rules to govern their life, which was to be simple and severe. But in the course of the centuries they fell from their high position, becoming mere strolling jugglers and soothsayers. It is from the black arts they were supposed to practise that we get our word "magic." The name survived until the Christian Era to designate learned men, especially astronomers. The New Testament tells how three magi, or wise men of the East, came to worship at the manger where the infant Jesus lay.

After the time of Alexander the Great, Zoroastrianism gradually declined. It received its deathblow in the middle of the 7th century with the Mohammedan invasion, though it still survives in a few remote districts of Iran and among the Indian Parsees.

Zurich (*zụ'rĭk*), Switzerland. The largest city of Switzerland, Zurich is also the Swiss center of banking and industry. It has developed into a modern metropolis without losing its historic charm. It lies on Lake Zurich in the cradle of the northern Swiss plateau, within view of the Alps and the Jura. From the lake the swift icy waters of the River Limmat flow through the city.

On this site stood the huts of lake dwellers many thousands of years ago. Here, in the first century of our era, the Roman conquerors built a town called Turicum. In the early Middle Ages, Zurich prospered under Charlemagne's protection, and in 1218 was declared a free town of the Holy Roman Empire.

Even before joining the Swiss Confederation in 1353, Zurich was noted for its building and other trades. Great churches began to rise. Two of these, the Gross Münster (built between the 11th and the 13th centuries) and the Frau Münster (13th–15th centuries), look out serenely today over stores, banks, factories, and the busiest streets in all Switzerland. It was at the Gross Münster that Zwingli launched his Protestant reforms (*see* Zwingli).

It was in Zurich that Johann Pestalozzi at the end of the 18th century conceived ideas which have revolutionized methods of teaching (*see* Education). Two of the city's best-known educational institutions are the University of Zurich (founded 1832) and the Federal Polytechnic School (founded 1855). The Central Library contains letters of Luther, Zwingli, Calvin, Henry IV of France, Frederick the Great, and many other celebrities. Priceless treasures of art draw throngs of visitors to the Swiss National Museum.

Ancient trade routes converging at Zurich have been transformed into railroads that bring into the city many raw materials for manufacture. The factories have grown so huge that the near-by homes of workers are numbered in thousands. The chief products are textiles and machinery, largely for export. The textiles are cotton, silk, and rayon. The machinery is for use in textile and electrical industries. Other manufactures are books and paper.

Zurich has long been a refuge for political and religious exiles. Tourists seek out the city for its beauty and climate. Nearly all the residents are of German descent; a few thousands trace their ancestry to Italy or France.

Since 1353 Zurich has served at various times as capital of the entire Swiss Confederation, but yielded this honor in 1848 to the more nearly central city of Bern (*see* Bern). Today Zurich is capital only of the canton of Zurich, which has an area of 668 square miles and a population of 777,002 (1950 census). Population of city, 390,020.

Zwingli (*tsvĭng' lĭ*), Ulrich (1484–1531). The Protestant Reformation, which came to Germany through Luther, was brought to Switzerland by Ulrich Zwingli. Although Zwingli's influence on the Protestant movement was not so great as Luther's, he made an important contribution to Protestant doctrine.

The son of a prosperous Swiss farmer, he received a good education at Swiss schools and at the University of Vienna. In 1516 he was appointed priest at the shrine of Einsiedeln. Influenced by Erasmus, he declared that people should be permitted to interpret the Bible for themselves. He also criticized abuses in the Roman Catholic church. (*See also* Reformation.)

In 1518 he was appointed preacher at the cathedral of Zurich, where, under the influence of Luther, he broke completely with the papacy. When Pope Adrian VI asked the people of Zurich to abandon Zwingli, the town council held a public debate in which Zwingli defended his views so ably that the canton decided to uphold the reformer and to withdraw from the church. Although other cantons followed Zurich, the five "forest cantons" remained zealously Catholic.

Zwingli's belief in the supreme authority of the Bible caused him to diverge from Luther on many points of doctrine. Furthermore, Zwingli, who was a political as well as a religious reformer, supported the Peasants' Revolt, while Luther opposed it.

Zwingli was slain in the battle of Kappel fought between the Catholic and Protestant cantons of Switzerland. A great boulder, standing a little way off the road, marks the place where he fell. It is inscribed, "'They may kill the body but not the soul': so spoke on this spot Ulrich Zwingli, who for truth and the freedom of the Christian Church died a hero's death, Oct. 11, 1531."

THE EASY REFERENCE
FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS
BEGINNING WITH

W-X-Y-Z

TO SAVE TIME

USE THIS INDEX

EDITOR'S NOTE ON NEXT PAGE TELLS WHY

SPECIAL LISTS AND TABLES

Numerous other lists and tables in the fields of geography, history, literature, science, mathematics, and other departments of knowledge will be found with their appropriate articles in the main text

EDITOR'S NOTE

EVERY user of Compton's Pictured Encyclopedia should form the habit of *first* turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

The arrangement of subheadings is alphabetical, except in major historical entries. In these the chronological order is followed.

The pictures illustrating a specific subject are indicated by the word *picture* or *color picture* followed by a volume indicator and a page number. A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read. The pictures are usually on the same page as the text to which you are also referred; sometimes they are found in a different but related article which will add interest and information.

The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated where usage is divided.

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are those of the latest census or an official estimate when available if no census has been taken since World War II. Distances between points are map or air distances, not distances by railroad.

THE EASY REFERENCE FACT-INDEX

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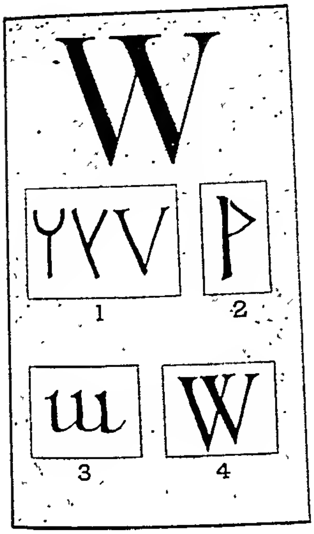

THE HISTORY of our letter W is very short, because the letter did not come into existence until after the Norman conquest of England in 1066. Until then, both 'v' and 'w' were indicated by much the same letter in Semitic, western Greek, and Latin (1), as told in the Fact-Index article on V. This was not as confusing as it might seem, because the sounds of 'v' and 'w' are much alike. This can be proved by pronouncing first 'vee' and then 'we'.

In early medieval times, however, the Anglo-Saxon runic writing developed a separate character (2) for the sound of 'w' as in 'we'. The Anglo-Saxons called the letter *wen*. After the Normans conquered England, they needed such a character for Anglo-Saxon words; but they had developed the practice of using two 'u's' (3) for this sound. They continued this, and gradually linked together two of the old pointed capital letters (4) for the new character. Thus English gained the letter W. We still indicate how the Normans invented the letter by our name for it—'double U'.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

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Waln (*wŏl*), **Nora** (born 1895), writer, born Grampian Hills, Pa.; lived in China and in Germany; wrote 'The House of Exile', picture of life on a Chinese estate; 'Reaching for the Stars' contrasts fine qualities of German people with brutalities of Nazis.
Walnut, a tree W-5–6, *pictures* W-5, *table* W-186c
butternut ("white walnut") B-370
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Walnut Canyon National Monument, in Arizona N-38c, *map* N-18
Walnut family, or **Juglandaceae** (*gū-glăn-dā'sē-ē*), a family of shrubs and trees, native to north temperate region, including the butternut, black walnut, English walnut, pecan, bitternut hickory, shagbark hickory, mockernut hickory, pignut hickory, and the wing nuts.
Walpi, a Hopi pueblo, *picture* I-92
Wal'pole, Horace, 4th earl of Orford (1717–97), English author and wit, called best of English letter writers; son of Robert Walpole, first earl of Orford; his 'The Castle of Otranto', a mystery tale, initiated romantic novel; 'Memoirs' and 'Journal' give valuable but biased pictures of his own times: E-379
Walpole, Sir Hugh Seymour (1884–1941), English novelist, born New Zealand, educated in England ('Fortitude'; 'The Duchess of Wrexe'; 'Jeremy'; 'The Cathedral'; 'Portrait of a Man with Red Hair'; 'Rogue Herries'; 'Judith Paris'; 'The Fortress'; 'Vanessa'; 'The Bright Pavilions').
Walpole, Robert, first earl of Orford (1676–1745), English prime minister under George I and II; born Houghton, Norfolk, England; father of Horace Walpole: C-4, E-368–9, G-66
Walpurgis (*väl-pụr'ḡēs*), or **Walburga, Saint** (754?–799?), English nun, missionary to Germany, regarded as protectress against witchcraft; hence May Day eve, the time of witches' carnival according to German legend, is called Walpurgis night
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Walrus, a seallike animal W-6, *pictures* W-6
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Walsall (*wọl'sọl*), England, manufacturing town 8 mi. n.w. of Birmingham; pop. 114,514; leather goods, spirits, iron and brass products: *map, inset* B-324
Walsenburg, Colo., town 150 mi. s. of Denver; pop. 5596; site of a 17th-century Spanish village; present town laid out in 1873; center for coal mining, agriculture, livestock: *map* C-409
Walsh, Thomas James (1859–1933), legislator, born Two Rivers, Wis.; Democratic senator from Montana after 1913; investigated illegal leasing of government oil reserves in President Harding's administration; aided in drafting prohibition and woman suffrage amendments to United States Constitution.
Wal'singham, Sir Francis (1530?–90), English statesman and diplomat, secretary of state under Queen Elizabeth I; maintained army of spies in foreign courts; exposed Babington plot to murder the queen and influenced Elizabeth to sign Mary Stuart's death warrant.
Waltari, Mika Toimi (*mĭ-kạ toi-mĭ väl'tä-rĭ*) (born 1908), Finnish author, born Helsinki, Finland (historical novels: 'The Egyptian', 'The Adventurer', 'The Wanderer', and 'The Dark Angel').
Walter (*väl'tẽr*), **Bruno** (born 1876), musical conductor and composer, born Berlin, Germany; conductor, opera houses at Vienna, Munich, and Berlin; came to U.S. 1939; conducted Metropolitan Opera orchestra, New York City; musical adviser, New York Philharmonic-Symphony Orchestra 1947–49; autobiography, 'Theme and Variations'.
Walter (*wŏl'tẽr*), **Eugene** (1874–1941), playwright, born Cleveland, Ohio ('Paid in Full'; 'The Easiest Way'; 'Fine Feathers').
Walter, Hubert (died 1205), English statesman and archbishop of Canterbury; went with Richard I on Third Crusade; justiciar 1193–98; instrumental in preventing John's revolt against Richard; virtual ruler of England in Richard's absence 1194; chancellor 1199–1205.
Walter the Penniless, French knight, leader of early Crusade C-519
Wal'tham, Mass., city 10 mi. n.w. of Boston, on Charles River; pop. 47,187; one of largest watch centers in world; textiles, shoes, clocks, furniture; Brandeis University: *map, inset* M-132
first power loom in U. S. T-100
Waltham Abbey, or **Waltham Holy Cross**, England, market town on river Lea, 12 mi. n. of London; pop. 8197; name from abbey founded by King Harold; government rifle factory: *map, inset* B-325
Walther von der Vogelweide (*väl'tẽr fōn dĕr fō'ḡl-vī-dŭ*) (1165?–1230?), German minnesinger, one of greatest German lyric poets.
Walton, George (1741–1804), signer of Declaration of Independence; born Frederick County, Va.; Georgia delegate to Continental Congress 1776–8, 1780–1; elected governor Georgia 1779, 1789; U. S. senator 1795–96
signature reproduced D-37
Walton, Izaak (1593–1683), English writer; after retiring about age of 50 from successful iron business, he wrote 'The Compleat Angler' (sometimes called "The Bible of Fishermen"), a quaint delightful expression of the pleasures of outdoor life; also wrote biographies of John Donne, Sir Henry Wotton, Richard Hooker, George Herbert, and Bishop Robert Sanderson
'Compleat Angler', quoted S-427
theory of origin of eels E-267
Walton, William Turner (born 1902), English composer, born Oldham, England (oratorio, 'Belshazzar's Feast'; 'First Symphony'; musical parodies 'Facades' for Edith Sitwell's satirical poems; violin concerto for Jascha Heifetz).
Waltz, a dance in ¾ time, probably evolved from German folk dances; became popular in 19th century; also music for the dance or in its rhythm: *diagram* D-14m
Wa'tzing mouse, a breed of the common mouse, supposedly of Japanese origin, often kept as a pet; a derangement of its inner ear makes it often move in circles.
Waltz opera, a form of light opera O-307
'The Merry Widow' O-397, *picture* O-396
Walvis Bay, name of territory, and also of its seaport and bay, on coast of South West Africa. The territory (374 sq. mi.; pop. 3327) is an exclave of Cape Province, but is administered by South West Africa: *maps* A-47, S-242
Wampano'ag, a powerful Algonquian Indian tribe whose proper territory was the peninsula on the e. shore of Narragansett Bay, R. I., and the adjacent parts of Massachusetts, but the tribal chiefs ruled a much larger territory
King Philip's War K-46–7
treaty with Pilgrims P-325
Wam'pum, beads made of shells used in various ways by North American Indians S-141, *pictures* I-108d, M-337
Wan'amaker, John (1838–1922), merchant, born Philadelphia, Pa.; built two of largest department stores in U. S., in New York City and in Philadelphia; U. S. postmaster general 1889–93; religious and philanthropic work: H-274–5
Wandering albatross A-140
Wandering Jew, legendary character (sometimes called Ahasuerus) W-6–7
Wandering Jew, or **spiderwort**, a plant W-7
Waneta (1795?–1848), Sioux Indian chief, born South Dakota; fought on side of British in War of 1812 and was rewarded with captaincy and trip to England; favored Americans after 1820 when attempt to destroy Fort Snelling was prevented; signed trade treaty at Fort Pierre (1825) and at Prairie du Chien (1848).
Wang Ching-wei (*wäng' ḡing'wā'*) (1885–1944), Chinese nationalist, born Canton, Kwangtung; deputy leader of Nationalist (Kuomintang) party at outbreak of Sino-Japanese War 1937; made ruler of Japanese-sponsored Chinese National government 1940.
Wang Wei (*wäng'wā'*) (699–759), Chinese painter and poet; especially celebrated for founding monochrome landscape tradition in Chinese painting; spent his later years in Buddhist monastery.
Wangyehmiao, Manchuria. *See in Index* Ulan Hoto
Wapiti (*wŏp'ĭ-tĭ*), an elk W-7
Wappato, also **Wapato** (*wŏp'ạ-tō*), bulblike root of a species of arrowhead (*Sagittaria variabilis*); found in Northwest, eaten by Indians.
Wappinger, an Algonquian Indian confederacy, closely related to the Mahican and the Delaware, whose tribes occupied the e. bank of Hudson River, from Poughkeepsie, N. Y., to Manhattan Island and the country e. of Connecticut River.
War. *See also in Index* Peace movement; Warfare. For list of the great wars of history, *see table* on the following page
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War, Department of, U. S. (1947–49 Department of the Army, since 1949 part of the Department of Defense): U-360. *See also in Index* Army, Department of the; Defense, Department of
development under Theodore Roosevelt R-220, 222
War, god of, in mythology

SOME OF THE GREAT WARS OF HISTORY

American Revolution (1775–83): Successful revolt of the Thirteen English Colonies in America against British rule; Bunker Hill, Saratoga, Yorktown; independence recognized by Great Britain.

Austrian Succession (1740–48): Concerted action of continental powers to appropriate desirable pieces of Hapsburg lands from Maria Theresa, whose cause was championed by Great Britain; waged between Austria and its allies on one side and France and its allies on the other; war ended with mutual restoration of conquests, except Silesia, which was retained by Prussia. In America called King George's War in which English fought the French.

Austro-Prussian (1866): "Seven Weeks' War," arising out of differences over Schleswig-Holstein question; resulted in overwhelming defeat of Austria at Sadowa, and subsequent exclusion from German federation.

Balkan Wars (1912–13): Attempt of Balkan allies to expel Turkey from Europe; remarkable successes were minimized by subsequent quarrels between allies over newly won territory, enabling Turkey to retain its hold on Constantinople and surrounding territory.

Boer War (1899–1902): Spirited, but futile resistance of Boer settlers in South Africa to extension of British claims; Transvaal and Orange Free State made British colonies.

Chinese-Japanese War (1894–95): Occasioned by rival pretensions in Korea; a complete victory of Japan's modern military machine over China's antiquated forces; Japan forced by European powers to restore all conquests except Formosa.

Civil War in England (1642–49): Struggle between the Crown and Puritan Parliament over distribution of ecclesiastical and civil jurisdiction; Marston Moor and Naseby; execution of Charles I and establishment of commonwealth.

Civil War in the United States (1861–65): Between Union government and Southern Confederacy over latter's attempt to secede from Union; Vicksburg, Gettysburg; Union preserved.

Crimean (1853–56): Undertaken by Great Britain with aid of other powers in defense of Turkey against Russian aggressions; siege of Sebastopol; Turkey left intact.

Crusades (1096–1291): Romantic military expeditions of western princes and prelates to recover Holy Sepulchre from Saracens; capture of Antioch, Jerusalem, and Acre; later Crusades were diverted to other ends and Holy Land lapsed into Mohammedan control.

Dutch Independence (1568–1648): Led by William of Orange; Dutch threw off oppressive Spanish rule and established independent government; siege of Leyden.

Franco-Prussian (1870–71): Clash between Prussia's imperialistic aspirations and the jealousy of Napoleon III, resulting in humiliating defeat of France, downfall of the Second Empire; and proclamation of German Empire; Sedan, siege of Paris.

French Revolution (1792–99): Great Britain headed coalition of Prussia, Austria, and other countries against France in contest that was last phase of long wars between England and France for colonial and maritime supremacy and also clash between two political systems; Valmy, Italian campaign; peace made with all allies except England; Egyptian expedition.

Great Northern (1700–21): Undertaken by Russia aided by Denmark and Poland to secure Baltic port at expense of Sweden; siege of Narva, Poltava; Russia secured provinces about Gulf of Finland and Sweden sank to secondrate power.

Greek Independence (1821–29): Greeks threw off Turkish yoke and revived national independence.

Hundred Years' (1337–1453): Series of conflicts between rulers of France and England over disputed titles to French throne and territories; Crécy, Poitiers, Agincourt, Orléans; England lost French possessions except Calais; French monarchy firmly established.

Mexican (1846–48): Arose from annexation by the United States of former Mexican territory of Texas and ensuing boundary disputes; resulted in complete American victory, establishment of the Rio Grande as the boundary, and cession of upper California and New Mexico to United States.

Napoleonic (1799–1815): Determined resistance of Allied European powers to aggressions of Napoleon, ending in his downfall: Austerlitz, Leipzig, Trafalgar, Waterloo.

Peloponnesian (431–404 B.C.): Between rival states of Athens and Sparta for economic and political control of Greece; Athenian expedition to Syracuse, Aegospotami; Athenian supremacy ended.

Persian (493–479 B.C.): Expeditions of Persian emperors against Greece to punish Athens for aiding revolting Persian colonies in Asia Minor, and to extend empire; Marathon, Thermopylae, Salamis, Plataea; Greece maintained independence and control of Aegean.

Punic Wars (264–241, 218–202, 149–146 B.C.): Death struggle of Rome and Carthage for domination of Mediterranean world; Hannibal's invasion of Italy, Cannae, Zama, Metaurus; Carthage taken and destroyed.

Russo-Japanese (1904–5): Blow dealt by Japan to Russian aggression in Far East; siege of Port Arthur, battle of the Sea of Japan; Japanese interests in Korea recognized as paramount, and Japan established as a first-rate power.

Russo-Turkish (1877–78): Arose indirectly from complicated Balkan situation and directly from Mohammedan uprising against Balkan Christians; fall of Plevna; power of Turkey in Europe practically destroyed, only to be resuscitated by Congress of Berlin.

Seven Years' (1756–63): Resulted from alliance formed against rapidly expanding Prussia by Austria, Russia, France, and other powers; Great Britain allied with Prussia; battles of Rosshach, Leuthen, Quebec; Prussia established as great nation, and foundation of British Empire laid. France expelled from North America by Great Britain. Called French and Indian War in America.

Spanish-American (1898): Outcome of American sympathy for Cuban revolutionists; established Cuban independence and practically ended Spain's colonial empire, remnants of which were ceded to United States; Manila Bay and Santiago.

Spanish Civil War (1936–39): Successful revolt by Spanish Fascists supported by Italy and Germany against the government of the Spanish Republic; victory of the "Popular Front" parties in 1936 elections inspired the revolt.

Spanish Succession (1701–13): Attempt of England, Austria, and allies to prevent establishment of a French prince on Spanish throne; Blenheim; Bourbon House established in Spain, but Austria and England gained extensive French and Spanish possessions. Called Queen Anne's War in America.

Thirty Years' (1618–48): Struggle between Catholics and Protestants of Germany in which Gustavus Adolphus of Sweden played a brilliant part; Leipzig, Lützen; religious and territorial differences settled at price of utter devastation of Germany.

Trojan (c. 1100 B.C.): Waged by Greek princes against King Priam to avenge abduction of Helen, wife of Menelaus of Sparta (myth.); siege and fall of Troy.

War of 1812 (1812–14): Between United States and Great Britain, caused by Great Britain's claims to right of search of American vessels on high seas and impressment of seamen; treaty adjusted boundaries, etc., leaving main cause of war unmentioned.

Wars of Alexander the Great (334–323 B.C.): Persian Empire completely overthrown in battles of Granicus, Issus, and Arbela; conquest of Syria, Palestine, and Egypt; invasion of Media.

Wars of the Roses (1455–85): Waged by Houses of Lancaster and York, rival claimants to English throne, until royal marriage united the two lines; Bosworth Field.

World War I (1914–18): A struggle between Central Powers and Allied and Associated Powers, arising indirectly from clash between two rival systems of commercial imperialism, and directly from diplomatic tangle following murder of Archduke of Austria by a Serb; Central Powers crushed.

World War II (1939–45): A conflict between Allied nations (chiefly United States, Great Britain, Russia, France, and China) and Axis powers (Germany, Italy, and Japan), wherein Allies—after six years of strife on continents of Europe and Asia and in Pacific Ocean—halted aggression of Axis countries and finally defeated them.

SOME FAMOUS WATERFALLS

Noted for Height

	Feet
Angel, Venezuela	*2654*
Ribbon Fall, Yosemite	1612
King George VI, British Guiana	1600
Roraima, British Guiana	1500
Upper Yosemite	1430
Gavarnie, Pyrenees	1385
Takkakaw, British Columbia	1200
Staubbach, Switzerland	980

Noted for Volume and Height

	Feet
Kaieteur, British Guiana	740
Victoria Falls, South Africa (av.)	343
Iguassú, Brazil-Argentina	215
Niagara Falls	167

about 13 mi. e. of Erfurt; pop. 66,-659; famed for poets and musicians; constitution of German republic adopted at Weimar in 1919: G-98, *maps* G-88, E-424-5
Goethe G-130
Liszt L-266
Schiller S-57

Weimaraner, a hunting dog; long ears and nose; tail usually clipped to 1½ in. when puppy; originated in Germany in early 19th century: *color picture* D-112, *table* D-118

Weinberger, Jaromir (born 1896), Czech composer, born Prague; taught composition at Ithaca Conservatory, Ithaca, N. Y., 1922-26; wrote operas, most famous 'Schwanda the Bagpiper'.

Weiner, Leo (born 1885), Hungarian composer of orchestral music, chamber pieces, and other music, in classical style.

Weingartner (*vīn'gärt-nẽr*), **Felix** (1863-1942), Austrian musical conductor and composer, born Dalmatia; conductor Berlin, Munich, Vienna; with Boston (Mass.) Opera Company 1912, 1913; composed operas ('Sakuntala'), orchestral and chamber music, piano pieces, songs; wrote 'On Conducting', 'The Symphony Since Beethoven'.

Weinman, Adolph Alexander (1870-1952), American sculptor, born Germany, came to U. S. at age of 10 ('Indian Head'; Lincoln memorials).

Weinsberg (*vīns'bĕrĸ*), Germany, town 28 mi. n.e. of Stuttgart; victory of German king Conrad III over Count Welf of Bavaria 1140; once free imperial city.

Weir (*wēr*), **J(ulian) Alden** (1852-1919), impressionist painter, born West Point, N. Y., son of Robert Walter Weir.

Weir, Robert Walter (1803-89), portrait and historical painter, born New Rochelle, N. Y.; father of Alden Weir; for 42 years taught drawing at U. S. Military Academy ('The Embarkation of the Pilgrims', in U. S. Capitol; 'Landing of Hendrik Hudson').

Weir, a dam D-10

Weirton, W. Va., city 26 mi. n.e. of Wheeling, on Ohio River; pop. 24,005; steel and tin mills; steel products: *map, inset* W-107

Weiser (*wē'zẽr*), Idaho, town at confluence of the Snake and Weiser rivers, 56 mi. n.w. of Boise; pop. 3961; center of farming region; near greatest canyon of Snake River: *map* I-21

Weisgard, Leonard (born 1916), artist, illustrator, and author of children's books, born New Haven, Conn.; received Caldecott medal 1947 for his illustrations for 'The Little Island', by Margaret Wise Brown; also illustrated her 'Golden Egg Book' and 'Red Light, Green Light' and Alvin Tresselt's 'Rain Drop Splash'; wrote and illustrated 'Pelican Here, Pelican There' and 'Clean Pig'.

Weismann (*vīs'män*), **August** (1834-1914), German biologist; advanced theory that changes in the characteristics of a species are due to changes in germ plasm: H-344

Weizmann, Chaim (*ĸī'yim vīts'män*) (1874-1952), president of Israel, Zionist leader, and chemist, born in Russia; during World War I invented synthetic acetone and helped to perfect TNT; after 1935 director of Daniel Sieff Research Institute at Rehovoth, Palestine; several times president of World Zionist Organization; named provisional president of Israel 1948, elected first president 1949, re-elected 1951 ('Trial and Error', autobiography): I-257, *picture* I-258
Balfour declaration P-46

Welch, William Henry (1850-1934), pathologist, born Norfolk, Conn.; held first chair of pathology in America 1879-84 at Bellevue Hospital Medical School, New York City; organized School of Hygiene and Public Health at Johns Hopkins University; fostered school hygiene, helped organize departments of health in many cities and states.

Welding W-90
blacksmithing B-204*a*, W-90, *picture* B-204*a*
drafting M-157*h*
electric W-90
helium used in H-331
oxyacetylene A-7, *picture* A-8
thermite A-183
X rays, test X-331

Weldon, Walter Frank Raphael (1860-1906), English zoologist, one of leaders in developing science of biometry; professor at Oxford University.

Welfare Island, N. Y., formerly called Blackwells Island; between Manhattan and Long Island in East River; devoted to hospitals, asylums, penal institutions: *map* N-222

Welfare work. *See in Index* Child welfare; Social service

Welf G-222*d*. *See also in Index* Guelfs and Ghibellines

Welhaven (*vĕl'häv-ĕn*), **Johann Sebastian Cammermeyer** (1807-73), Norwegian poet, critic; inspired by old Norse subjects; conservative, opposed extravagances of Henrik Wergeland ('Norges Daemring', sonnet cycle).

Well, *pictures* W-62. *See also in Index* Pump
artesian A-389-90, *diagram* A-389
China's deep wells W-73
desert D-73*a*, *picture* S-15
natural gas G-33
oasis D-73*a*
oil P-170-3. *See also in Index* Petroleum, *subhead* wells
pumps, *pictures* W-62
sweep, *pictures* B-25, H-450, I-249
village well in India, *picture* I-60

Welland, Ontario, Canada, city on Welland Ship Canal and River; pop. 15,382; government docks and turning basin, hydroelectric plants, cotton and planing mills, iron and steel manufactures: *maps* C-72, *inset* C-68, *picture* C-76

Welland River, in e.-central England, flows 70 mi. n.e. to The Wash, *map* B-325

Welland Ship Canal, Canada, connecting Lake Erie with Lake Ontario W-90, *maps* G-179, N-230, *inset* C-68, *picture* C-76, *picture-map* N-231. *See also in Index* Canal, *table*

Weller, Sam, a character in Charles Dickens' 'Pickwick Papers' D-84*b*

Weller, Thomas Huckle (born 1915), physician, born Ann Arbor, Mich.; on faculty Harvard school of public health after 1948, professor of tropical public health and head of department after 1954; with J. F. Enders and F. C. Robbins won 1954 Nobel prize in medicine and physiology for work on growth of polio virus for vaccine.

Weller, Tony, in Charles Dickens' 'Pickwick Papers', an old coachman, the father of Sam Weller.

Welle River, in w. Africa. *See in Index* Uele

Welles (*wĕlz*), **(George) Orson** (born 1915), actor, writer, and producer for radio, theater, and motion pictures; born Kenosha, Wis.; at age of 22 founded Mercury Theater, New York City, and directed and produced modernized version of Shakespeare's 'Julius Caesar'.

Welles, Gideon (1802-78), statesman, born Glastonbury, Conn.; able secretary of navy under Presidents Lincoln and Johnson; though ignorant of navigation and ship construction, he showed great executive ability and was of value to Lincoln as adviser on general policies: *picture* L-249

Welles, Sumner (born 1892), diplomat, born New York City; secretary of Tokyo embassy 1915-17, Buenos Aires 1917-19, Dominican Republic 1922; delegate to many conferences on Latin American affairs; opened way for good-neighbor policy; ambassador to Cuba 1933; undersecretary of state 1937-43: *picture* W-255

Wellesley (*wĕlz'lĭ*), **Richard Colley, marquis of** (1760-1842), British statesman, one of greatest English colonial administrators, governor general of India 1797-1805; "found the (British) East India Co. a trading body, left it an imperial power"; brother of duke of Wellington.

Wellesley, Mass., town 15 mi. w. of Boston, chiefly residential; pop. of township 20,549; settled 1660, incorporated 1881: *map, inset* M-132

Wellesley, Province, Malay Peninsula. *See in Index* Penang Island

Wellesley College, at Wellesley, Mass.; for women; chartered 1870; opened 1875; arts and sciences: *picture* M-136

Wellington, Arthur Wellesley, first duke of (1769-1852), British soldier and statesman W-90-1, *picture* W-90
Catholic Emancipation Act O-337
Waterloo W-66

Wellington, port and capital of New Zealand on s. coast of North Island; on Cook Strait; pop. 133,414, with suburbs; large trade; varied manufactures; Victoria College of University of New Zealand: N-228, *maps* N-228, P-16, *inset* A-489, *picture* N-228*a*

Wells, Carolyn (1869-1942), writer of mystery stories, parodies, and humorous verse, born Rahway, N. J.; noted especially for the Fleming Stone detective stories.

Wells, David Ames (1828-98), political economist, born Springfield, Mass.; free trade advocate; influenced creation of Federal Bureau of Statistics in U.S. Department of the Treasury.

Wells, Henry (1805-78), pioneer expressman, born Thetford, Vt.; president American Express Company 1850-68; founded Wells College 1868: E-458*a*

Wells, Herbert George (1866-1946), English author W-91, E-382*a*, *picture* W-91
'The War in the Air', *picture* E-382*a*

Wells, Horace (1815-48), American dentist, early user of anesthetics A-246

Wells, England, city 18 mi. s.w. of Bath; pop. 5835; 13th-century cathedral; important Saxon town; made bishop's see in 905: *map* B-325

Wells, Fargo & Company E-458*b*-*c*, *d*
vehicles used: stagecoach E-458*c*, *picture* E-458*b*; truck, *picture* E-458*c*; wagon, *picture* E-458*b*

Wells College, at Aurora, N. Y.; for women; founded 1868; arts and sciences.

Well sweep, *pictures* B-25, H-450

mining area; gold, copper, silver; farming; cap. Perth: *map* A-488
Wolf Creek Crater M-180
Western balsam poplar. *See in Index* Black cottonwood
Western Basins and Plateaus, in U.S. *See in Index* United States, *subhead* geographic regions, Western Basins and Plateaus; *also* names of states in this region
Western bluebird B-212
Western civilization
birth and development W-209–12, *Reference-Outline* W-212–14: early centers, *map* W-209; spread of, *map* W-210. *See also in Index* Civilization
Western College for Women, at Oxford, Ohio; founded 1853; arts and sciences; vocational training for community theater, radio, secretarial studies, teaching.
Western Conference, or Big Ten, in football F-231
Western cricket. *See in Index* Mormon cricket
Western crow C-519
Western Dvina River, in n. Russia. *See in Index* Dvina River
Western Empire, in Roman history R-188, E-431
Western European Union (WEU), seven nation defense organization proposed by Britain in 1954; in effect with signing of Paris pacts May 5, 1955; includes Britain, France, West Germany, Belgium, Italy, Luxemburg, Netherlands; responsible for supervision of Independent Saar; secretariat in London: F-274*a*
Western grasshopper. *See in Index* Mormon cricket
Western grebe G-187
Western Hemisphere, *diagram* E-176
Western hemlock, an evergreen tree (*Tsuga heterophylla*) of the pine family; grows 130 ft. to 150 ft. high; may live to 500 years. Bark thin; wood pale brown with pink tinge. Used as core stock for plywood. Sometimes called west coast hemlock, hemlock spruce, hemlock fir, Prince Albert fir, gray fir, and Alaska pine: H-332, *table* W-186*b*
Western Isles, off w. coast of Scotland. *See in Index* Hebrides Islands
Western juniper J-365
Western Kentucky State College, at Bowling Green, Ky.; founded 1906; arts and sciences, teacher training; graduate division in education.
Western Maryland College, at Westminster, Md.; Methodist; opened 1867; arts and sciences, education, home economics, library science, music; graduate studies.
Western meadowlark, bird M-148
state bird, *table* B-158
Western Michigan College of Education, at Kalamazoo, Mich.; state control; opened 1904; arts and sciences, education, music; graduate study.
Western Ontario, University of, at London, Ontario, Canada; municipal control; founded 1878; arts and sciences, business administration, medicine, nursing; graduate studies.
Western paper birch B-155
Western red birch B-155
Western red cedar, or giant arborvitae, an evergreen tree; lives over 1000 years; pyramid-shaped. Leaves bright green, glossy, with white marks on underside; cone ½ in. long; sometimes called canoe cedar, shinglewood, Pacific red cedar, arborvitae, and red cedar pine. Wood red-brown or almost white, light, aromatic; often called simply cedar: A-296, *table* W-186*b*
Western Reserve, part of Northwest Territory (now n.e. Ohio) reserved by Connecticut when latter ceded its claim to western lands C-451
Cleveland founded O-362
Western Reserve University, at Cleveland, Ohio; founded 1826; arts and sciences, applied social sciences, architecture, business, dentistry, law, library science, medicine, nursing; graduate school.
Western Samoa, islands of Samoa w. of 171° w. longitude; 1130 sq. mi.; pop. 68,197; chief islands, Savaii and Upolu; cap. Apia on Upolu. New Zealand administered Western Samoa as mandate after World War I and as trusteeship after World War II: S-35, *map* P-17. *See also in Index* Samoa
Western State College of Colorado, at Gunnison, Colo.; state control; founded 1901; opened 1911; arts and sciences, business, education; graduate studies.
Western States, U. S., *Reference-Outline* U-338
Western tanager T-10
Western Trail, Texas to Nebraska C-152
Western Turkestan T-213, 214
Western Union Telegraph Company, beginnings M-396
Western Washington College of Education, at Bellingham, Wash.; state control; opened 1899; arts and sciences, education; graduate study in education.
Western white fir. *See in Index* Giant fir
Western white pine, evergreen tree (*Pinus monticola*) of pine family. Grows 90 ft. to 150 ft. Branches short, forming narrow crown. Leaves to 4 in. long, grow in clusters of 5, blue-green with white tinge. Cones to 11 in. long. Bark broken into square blocks: *table* W-186*b*
Western yellow pine, or ponderosa pine P-258
Western yew Y-339
Westfield, Mass., town on Westfield River about 10 mi. w. of Springfield; pop. 20,962; machinery, toys, paper; State Teachers College: *map* M-132
Westfield, N. J., residential town 9 mi. s.w. of Newark; pop. 21,243: *map* N-164
West Fiord, Norway. *See in Index* Vestfiorden
West Florida, name given by British in 1763 to that part of Florida between Apalachicola River and the Mississippi River and as far north as 32° 28′: F-150
West Fork River, W. Va., 92 mi., rises in Upshur County, flows n.e. to Fairmont W-99–100, *map* W-106
West Frankfort, Ill., city in s. 83 mi. s.e. of St. Louis, Mo., in rich coal region; pop. 11,384: *map* I-37
West Germany, or **Federal Republic of Germany,** country in the land of Germany; area 95,867 sq. mi.; pop. 49,732,824; cap. Bonn: G-87, 102, E-439, *map* E-424–5
education E-263
flag F-136*b*, *color picture* F-132
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population, *graph* P-371: birth and death rates, *graph* P-372
sovereignty regained E-439, E-287*f*
West Goths, or Visigoths G-143. *See also in Index* Visigoths
West Ham, suburb of London, England, on e.; pop. 170,987; railroad works, chemicals: *map, inset* B-325
West Hartford, Conn., residential town, suburb of Hartford; pop. of township 44,402; machine tools; St. Joseph College: *map* C-444–5
West Hartlepool, England. *See in Index* Hartlepool
West Haven, Conn., residential and industrial suburb of New Haven: pop. of township 32,010: *map* C-444
West Highland white terrier, dog native to Scotland, *table* D-119
West Indies, island group in Atlantic Ocean n. and e. of Caribbean Sea; about 92,000 sq. mi.; pop. about 16,000,000: W-93–7, *maps* W-96–96*a*, N-251, *pictures* W-93, 95, *Reference-Outline* N-266. *See also in Index* names of islands and groups
American Colonies, trade with P-423, W-97
Bahamas B-17, *map* B-17, *picture* B-17
Barbados B-54
Caribbean Sea C-122
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cloves C-360
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Columbus reaches C-418*b*, 419, W-93
Cuba C-526–8, *map* C-528, *pictures* C-526–7
Dominican Republic D-123–5, *pictures* D-123–4
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Jamaica J-290 292, *picture* J-292
Las Casas' work L-105
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Trinidad T-189–90: tea T-32–3
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who owns, *table* W-94
Westinghouse, George (1846–1914), American inventor and manufacturer W-98, *picture* W-98
air brake B-284–5, R-65–6, W-98, *diagrams* B-284: patented, *table* I-199
West Lafayette, Ind., city on Wabash River opposite Lafayette; pop. 11,873: *map* I-78
Purdue University, Memorial Union Building, *picture* I-82
West Liberty State College, at West Liberty, W. Va.; state control; chartered 1837; arts and sciences, business, dental hygiene, education, music.
West Locris, district of ancient Greece. *See in Index* Locris
Westmacott, Sir Richard (1775–1856), English sculptor, born London; studied with Canova (pediment figures of British Museum; 'Achilles', Hyde Park, London).
Westmar College, at Le Mars, Iowa; controlled by Evangelical United Brethren Church; founded 1900; liberal arts.
West Mifflin, Pa., in Allegheny County, 8 mi. s.e. of Pittsburgh; pop. 17,985: *map, inset* P-132
Westminster, city and metropolitan borough of London, England; pop. 98,895; royal palaces, Westminster Abbey, Houses of Parliament, cathedral, National and Tate galleries: L-298
Westminster, Palace of, in London, England L-304
Westminster, Statute of (1931), Great

Democrat and an ex-Confederate soldier, he was appointed to head the Supreme Court by a Republican president, William Howard Taft
will W-134

White, Eliza Orne (1856–1947), author, born Keene, N. H.; her stories portray everyday life of children in America ('A Little Girl of Long Ago'; 'When Molly Was Six'; 'Adventures of Andrew'; 'Patty Makes a Visit').

White, Elwyn Brooks (born 1899), writer, born Mount Vernon, N. Y.; became well known as writer for *New Yorker* magazine; departmental editor *Harpers* magazine ('Every Day Is Saturday'; 'The Lady Is Cold'; 'Quo Vadimus?'; 'The Second Tree from the Corner').

White, Gilbert (1720–93), English country parson and naturalist; his 'Natural History and Antiquities of Selborne' has become a classic.

White, Hugh Lawson (1773–1840), jurist and political leader, born Iredell County, N. C.; judge of the Tennessee supreme court 1809–15, U. S. senator from Tennessee 1825–40; as a candidate for U. S. presidency in 1836 carried Tennessee and Georgia.

White, John (1575–1648), English prelate, born Oxfordshire, England; in 1628 helped to found the Massachusetts Company; his 'Planters' Plea', first accurate account of the New England colony.

White, John (flourished 1585–93), governor of "lost colony" of Roanoke N-278

White, Josh (born 1915), Negro ballad singer and actor, born Greenville, S. C.

White, Maria (died 1853), American poet, wife of James Russell Lowell L-337–8

White, Peregrine, or Peregriene (1620–1704), first white child born in New England, born aboard the *Mayflower*, in Cape Cod harbor.

White, Richard Grant (1821–85), writer and critic, born New York; Shakespearean scholar and philologist.

White, Stanford (1853–1906), architect, born New York City; killed by Harry K. Thaw in Madison Square Garden, which he designed. *See also in Index* McKim, Charles F.

White, Stewart Edward (1873–1946), novelist, born Grand Rapids, Mich. ('The Claim Jumpers'; 'The Blazed Trail'; 'The Silent Places'; 'Conjuror's House'; 'Wild Geese Calling'; and many other novels of western life)
'Daniel Boone', *picture* L-216*a*

White, Thomas Dresser (born 1901), U. S. Air Force officer, born Walker, Minn.; Air Force deputy chief of staff for operations 1951–53, vice-chief of staff after 1953; became 4-star general 1953.

White, Walter (Francis) (1893–1955), Negro author, born Atlanta, Ga.; a leader in the fight against lynchings; with National Association for the Advancement of Colored People from 1918, executive secretary 1929–55 ('Fire in the Flint'; 'Flight').

White, William Alanson (1870–1937), neurologist, born Brooklyn, N. Y.; author of treatises on nervous and mental diseases; head of St. Elizabeth's Hospital, Washington, D. C.

White, William Allen (1868–1944), journalist, born Emporia, Kan.; editor *Emporia Gazette;* author of sketches and stories of life in Middle Western towns ('In Our Town'; 'The Court of Boyville'; 'A Certain Rich Man'); also wrote biographies of Woodrow Wilson and Calvin Coolidge; posthumous Pulitzer award for his autobiography 1947.

White
electric-white effect F-93
harmonies with C-394
light L-232, C-395–400, L-233, S-331, *color diagrams* C-391, 398
neutral color C-392, 394, *color chart* C-393
tints formed by C-394

White angel. *See in Index* Spadefish

White ant. *See in Index* Termite

White armies, in Russian Revolution R-289, W-240–1

White arsenic A-388–9

White ash, a tree A-401, *pictures* T-181–3, *table* W-186*c*

White Aylesbury, a duck D-162

White balsam. *See in Index* White fir

White bass B-77

White basswood, local name applied to the linden tree L-254

White birch B-155

White-breasted nuthatch N-316, *color pictures* B-163, 186
nest, *color picture* B-163

White butterfly. *See in Index* Cabbage butterfly

White Canons. *See in Index* Premonstratensians

White cedar, name applied to wood of northern white cedar and southern white cedar. Northern white cedar is pale brown, soft, aromatic, fine grained, resistant to decay; used for posts, ties, ribs of canoes. Southern white cedar is pink, straight grained; used for buildings, woodenware, in spars for ships. Both used for poles, shingles, and boats. *See also in Index* Northern white cedar; Southern white cedar; Port Orford cedar

Whitechapel, slum district in s. London, England L-306
market, *picture* L-306

White clover, or Dutch clover C-359, 360, *picture* S-133

White coal W-68. *See also in Index* Hydroelectric power

White-collared mangabey, a monkey, *picture* M-348

White corpuscles, or leucocytes (*lū'kō-sīts*), in blood B-208, 210, D-103, *color picture* M-235, *diagram* B-209

White crappie, fish. *See in Index* Crappie

White-crowned sparrow S-328

White currant C-530

White elephant, rare albino elephant found in Asia; esteemed sacred in Indo-China and kept at great cost; name often applied to useless and costly possessions
in Siam (Thailand) E-326, S-169

White elm. *See in Index* American elm

White Elster, or Elster, river of central Germany emptying into Saale River 3 mi. s. of Halle; 115 mi. long.

White-eyed vireo V-477

Whiteface, name applied to Hereford cattle. *See in Index* Hereford

White-faced glossy ibis I-3

Whiteface Mountain, a peak of the Adirondacks in state of New York A-21

Whitefield, George (1714–70), English evangelist, leader of Calvinist Methodists; said to have preached 18,000 sermons; made 7 voyages to America, preaching everywhere from Georgia to New England; associated with John and Charles Wesley.

White fir, evergreen tree (*Abies concolor*) of pine family. Grows 50 ft. to over 100 ft.; may live 300 years. Pyramid-shaped crown; bark thick; leaves flat, to 2 in. long, 2 white bands on underside. Cones oblong, to 5 in. long, greenish or purplish. Sometimes called balsam fir, silver fir, blue fir, and white balsam. Wood odorless, white, lightweight: *table* W-186*b*

Whitefish, important fresh-water food fish W-121, F-115

Whitefish Bay, Wis., village on Lake Michigan, n. suburb of Milwaukee; pop. 14,665: *map, inset* W-172

White-footed mouse, deer mouse, or wood mouse, also called **dormouse** M-441, D-125, N-62, *picture* M-441

White Friars. *See in Index* Carmelites

White gold G-132, *table* A-174

White hake, a fish H-246

Whitehall, a street of London, England L-303–4, *map* L-301, *picture* L-303

Whitehall, former royal palace, London, England L-303

Whitehaven, England, seaport and coal- and iron-mining center on Irish Sea 36 mi. s.w. of Carlisle, England; pop. 24,624; shipyards, iron foundries: *map* B-325

Whitehead, Alfred North (1861–1947), English mathematician and philosopher, born Ramsgate, England; lectured in British universities; professor at Harvard University 1924–37 ('Introduction to Mathematics'; 'Science and the Modern World').

Whitehead, Robert (1823–1905), English engineer, inventor of Whitehead submarine torpedo T-156

Whitehead, William (1715–85), English poet; best work is verse tales in the style of La Fontaine; poet laureate 1757–85.

Whitehead torpedo T-156

White hellebore, an herb of the lily family, genus *Veratrum*, with poisonous roots
used as spray S-356

White heron, great white heron, or egret H-351

Whitehill, Clarence (1871–1932), dramatic baritone singer, born Marengo, Iowa; in opera at Bayreuth, Germany, and other European cities, Chicago, and New York City.

White Horse, capital (since 1951) of Yukon Territory, Canada, in s. center 100 mi. n. of Skagway, Alaska; pop. 2594; business center during gold rush: Y-348, *maps* C-68, 80, *picture* N-255

White House, or Executive Mansion, official residence of president of U.S., in Washington, D.C. W-122–5, W-31, *pictures* W-122–4, W-33
Easter egg rolling E-200
first motion picture in, *picture* T-4
hostesses W-125–30, *pictures* W-126–30

White House Office, U.S. U-358, *list* U-359

White Huns, or Ephthalites, also **Hephthalites**, tribe of central Asia, living near Oxus in 5th and 6th centuries
invade India I-67

White ibis I-2, *picture* I-2
scientific name I-3

Whiteing, Richard (1840–1928), English novelist remembered for 'No. 5 John Street', a vivid description of life in London slums.

White Island, in Arctic Ocean between Spitsbergen and Fridtjof Nansen Land
Andrée's balloon wrecked near P-350*a*, *picture* P-351

White king, a pigeon, *picture* P-255

White lead P-40
substitute A-168

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Key: cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fērn, thêre; īce, bĭt; rōw, wôn, fôr, nŏt, dọ; cūre, bŭt, rụde, fụll, bûrn; out;

WORLD WAR I CHRONOLOGY

1914

June

28. Archduke Francis Ferdinand and wife, of Austria-Hungary, assassinated by Serbian agitators at Sarajevo, Bosnia.

July

23. Austria-Hungary sends Serbian government 48-hour ultimatum of directions for punishment of agitators.
24. Austria not satisfied with reply to ultimatum by Serbia.
28. Austria-Hungary declares war on Serbia.
29. Russia begins mobilization; Austria bombards Belgrade, Serbia.
31. Germany sends ultimatum to Russia to cease mobilization; France receives note from Germany demanding to know if it will remain neutral in case of war.

August

1. Germany declares war on Russia; France mobilizes.
2. Germany sends ultimatum to Belgium demanding that German troops be allowed to cross Belgium unresisted; German troops enter Luxemburg.
3. King of Belgium appeals to King George of Britain; Germany declares war on France.
4. Britain demands Germany respect Belgian neutrality; Germany declares war on Belgium, invades Belgium, bombards Liége fortress; Britain declares war on Germany.
5. Russians invade East Prussia; British destroyer sinks German mine layer *Königin Luise.*
6. Austria declares war on Russia; British vessel *Amphion* sunk.
7. Germans take Liége, Belgium; main Russian forces enter East Prussia.
8. Montenegro declares war on Austria.
9. France declares war on Austria; Austria invades Russian Poland.
12. War declared by Britain on Austria, and by Montenegro on Germany; Austria takes Shabatz, Serbia, on drive south into Serbia.
14. France begins offensive into Alsace-Lorraine; Russians defeat Austrians at Sokal, Galicia, on Bug River.
15. Japanese ultimatum to Germany to remove vessels from Japanese waters and return Kiaochow territory to China.
17. Belgian government moves from Brussels to Antwerp; Serbs check Austrian advance near Shabatz; last Belgian fort at Liége falls.
18. Serbs victorious over Bosnian troops in Jadar River battle; France takes Saarburg, on Saar River, driving into Lorraine.
19. Belgian army retires to Antwerp; Germans take Louvain, Belgium.
20. Germans occupy Brussels; Russians capture Gumbinnen, East Prussia.
21. French defeated and retire from Alsace-Lorraine.
22. French defeated at battle of Charleroi; Belgians retreat to Sambre River.
23. Japan declares war on Germany and bombards Tsingtao, China; Germans attack British in Belgium, opening battle of Mons Canal; Germans take Namur, Belgium, on Sambre River; French retreat to Paris area; Austrians evacuate Shabatz and retire from Serbia, behind Save River.
25. Austria declares war on Japan; Germans take Landrecies and Sedan, northern France; Russians approach Königsberg, East Prussia.
26. French retreat south of Le Cateau; battle of Tannenberg, East Prussia, begins.
27. Longwy, France, surrenders to Germans; Russians advance on Lemberg, Galicia; Allies capture German colony of Togoland, Africa.
28. Austria declares war on Belgium; New Zealand fleet takes German Samoa; British defeat Germans in naval battle off Helgoland, North Sea.
31. Russia defeated at Tannenberg and begins evacuating East Prussia.

September

1. Germans take Soissons, France, as French retreat to Aisne River; Russians and Austrians begin battle for Lemberg, Galicia.
3. French government moves from Paris to Bordeaux; British retreat to Marne River: Russians take Lemberg.
6. Allies in France cease retreat and begin first battle of Marne River; Austrians and Russians battle at Rawa Ruska,

(Continued on the next page)

WORLD WAR I CHRONOLOGY—*Continued*

Galicia; Serbs invade southern Austria and capture Semlin.
8. Battle of Masurian Lakes, East Prussia, begins.
9. Germans retreat north to Soissons as battle of Marne ends.
10. Germans entrench on Aisne River; Russians defeat Austrians at Rawa Ruska, driving them back to San River and Przemysl.
13. Battle of Aisne River begins.
15. Germans defeat Russians in Masurian Lakes battle; Russians retreat to Niemen River; Czernowitz, Galicia, falls to Russians in drive to capture Carpathian mountain passes.
22. British cruisers *Aboukir*, *Cressy*, and *Hogue* sunk by German submarines; Russians take Jaroslaw and lay siege to Przemysl, controlling Galicia.
23. Germans take Saint-Mihiel, establishing salient.

October
8. Antwerp bombarded as Belgian troops evacuate city.
10. Antwerp falls to Germans.
13. Germans take Lille, France, in drive to Channel ports.
16. Battle of Yser River opens as Germans attack Dixmude, Belgium.
19. First battle of Ypres, Belgium, begins.
21. German offensive at Arras.
24. Boer rebellion under De Wet begins in South Africa.
25. Germans fail in first attempt to take Warsaw.
27. Belgians end battle of Yser River by opening dikes and flooding area.
29. Turks raid Odessa, Russian Black Sea port, with warships; German cruiser *Emden* sinks allied ships off Penang harbor.

November
1. Germans defeat British in naval battle off Coronel, Chile.
3. Germans bombard Yarmouth, England; Allies bombard Dardanelles forts; Russia declares war on Turkey.
5. Britain and France declare war on Turkey.
7. Tsingtao, China, falls to Japanese.
9. *Emden* destroyed by Australian cruiser *Sydney*.
10. Germans take Dixmude, Belgium.
17. Allies hold their lines as first battle of Ypres ends.

December
8. De Wet's rebellion suppressed; British navy victorious at Falkland Island; German naval squadron destroyed.
12. Russians retreat from Cracow, Galicia.
15. Serbs defeat Austrians, driving them across Drina River.
16. Scarborough and Hartlepool, England, bombarded by German cruisers.
25. British air raids on Brussels and Cuxhaven; second German attack on Warsaw fails; first Zeppelin raid on England.
27. Russians secure central passes through the Carpathian Mountains.

1915

January
8. French offensive opens second battle of Soissons.
15. French retreat from Soissons.
17. Russians control Bucovina, south of Czernowitz, Galicia.
18. Austrians recapture Czernowitz.
24. British navy defeats Germany in North Sea battle; German ship *Blucher* sunk off Dogger Banks.

February
2. Turks open attack on Suez Canal.
6. Russians advance in East Prussia to Tilsit.
12. Germans drive Russians from East Prussia.
18. German naval blockade of Britain begins.
19. Allied naval attack on Dardanelles forts.
21. Zeppelin raid on Calais, France.
28. Germans retreat from northern Poland.

March
10. British gain local successes at Neuve-Chapelle, France.
14. German warship *Dresden* sunk.
17. Russians take Memel, in northern Prussia, Baltic Sea port.
18. Allied naval attack on Dardanelles abandoned, and in retreat British ships *Irresistible*, *Ocean*, and *Bouvet* are sunk.
20. Zeppelin raid on Paris.
21. Germans retake Memel.
22. Besieged Austrian city of Przemysl taken by Russians.

April
14. Zeppelin raid on Northumberland, England.
22. Second battle of Ypres begins; first use of poison gas by Germans on French defenders at Ypres breaks allied lines.
25. British troops land on Gallipoli Peninsula, Dardanelles.
26. Treaty of London signed by Italy and Allies.

May
1. Turks attack Gallipoli.
7. British passenger ship *Lusitania* sunk; Germans advance over Wisloka River at Jaslo, Galicia.
9. French offensive in Artois; end of second battle of Ypres; Libau, Baltic Sea port, taken by Germans.
11. Russians retreat to San River as their lines are broken in Galicia.
12. Allied troops under General Botha take Windhoek, capital of German Southwest Africa; Germans take Libau, Russia.
15. Battle of San River begins; Austrians retreat to Perth River; Germans take Jaroslaw.
16. British offensive at Festubert, near Ypres.
23. Italy declares war on Austria.
24. Austrian navy raids Italian coast.
30. Italians capture Cortina d'Ampezzo in Alps.

June
3. Germans recapture Przemysl; Amara, Turkey, on Tigris River, taken by British.
9. Italians take Monfalcone, Austrian port on Gulf of Trieste; German Southwest Africa surrenders to British.
11. Russian victory on Dniester River in battle at Zuravno.
17. Russians evacuate Lemberg; French take German "labyrinth" of trenches north of Arras in battle of Artois.
18. Italian victory at Plava.
20. Russians defeated at Rawa Ruska.
22. Austrians take Lemberg and control Galicia.

July
1. Germans drive French back in Argonne.
2. Italian offensive on Isonzo River.
9. Austrian defeat at Krasnik, Galicia.
15. Allied conquest of German Southwest Africa complete.
18. Austrian submarine sinks *Giuseppe Gariboldi* in Adriatic Sea.
22. Germans lay siege to Ivangorod, Russian Poland.
25. Italians take Austrian island of Pelagosa, Adriatic Sea.
26. Russians evacuate Warsaw.

August
4. Germans take Ivangorod.
5. Germans take Warsaw.
6. British land at Suvla Bay, Dardanelles.
14. British transport *Royal Edward* sunk.
18. Germans cut Brest-Litovsk Railway.
20. Russians defeat German landing operations in Gulf of Riga; Italy declares war on Turkey.
21. Germans evacuate Gulf of Riga; British attack at Suvla Bay fails.
23. Allied fleet bombards Zeebrugge, Belgian seaport.
25. Germans take Brest-Litovsk.
26. Germans take Bialystok, Russian Poland.

September
4. British ship *Hesperian* sunk by submarine.
5. Czar Nicholas takes command of Russian armies.
12. Germans cut Petrograd-Vilna Railway in Russia.
16. Germans take Pinsk, Russia.
18. Germans take Vilna (Wilno), Russian Poland.
20. Bulgarians mobilize.
25. British take Loos, France; French victorious in Champagne area.

October
4. Allied troops land at Saloniki, Greece; Russia declares war on Bulgaria.
7. Germans and Bulgarians invade Serbia.
9. Germans capture Belgrade, Serbia.
12. Bulgaria declares war on Serbia.
15. Britain declares war on Bulgaria.
16. France declares war on Bulgaria.
18. Italy declares war on Bulgaria.
24. Germans open Danube River route to Constantinople.
29. British mine sweeper *Hythe* sunk at Gallipoli.

November
5. United States protests against maritime policy of England and France.
6. Fall of Nis, Serbia.
11. Russians again repulse German attack on Riga.
12. Germans take Belgrade-Constantinople Railway.
15. Austrians drive Russians across Styr River, Galicia.
17. British hospital ship *Anglia* sunk by mine.
23. Serbia taken by Central Powers; Serbian army retreats to Albania.

December
3. British retreat from Ctesiphon (south of Baghdad) to Kut-al-Amara, Turkey.
8. British evacuate Gallipoli Peninsula, Dardanelles.
9. Allied forces retreat from Serbia to Greece.
10. Greece surrenders Saloniki harbor to Allies.
16. German cruiser *Bremen* sunk in Baltic Sea.
21. Italians land at Avlona, Albania.
27. Russian victory at Toporoutz, between Perth and Dniester rivers.

1916

January
8. British warship *King Edward VII* sunk in North Sea.
9. Gallipoli Peninsula completely evacuated by British.
16. Russian offensive on Turkey's Armenian forts.
18. Allied warships bombard Bulgarian coast.
23. Austrians control Montenegro and Scutari area.

February
8. French cruiser *Admiral Charner* sunk by submarine.
14. Austrian air raid on Milan, Italy.
16. Russians take Erzurum, Turkey.
18. British take German Cameroons, Africa.
21. Germans attack Verdun forts.
28. Naval battle between British *Alcantara* and German raider *Greif* in North Sea; both ships sunk.

March
9. Germany declares war on Portugal.
17. Heavy bombardment of Verdun.
25. British destroyers and seaplanes raid Zeppelin sheds in Schleswig.
30. Hospital ship *Portugal* sunk by Turks in Black Sea.

April
10. Germans gain at Verdun.
14. British air raids on Constantinople.

(Continued on the next page)

WORLD WAR I CHRONOLOGY—*Continued*

17. Italians take Col di Lana summit in Alps.
21. German cruiser and submarine attempt to land arms in Ireland.
24. Irish rebellion against British.
29. British surrender to Turks at Kut-al-Amara, Turkey.

May
1. Zeppelin raids on Scotland and England.
2. Irish rebellion suppressed.
15. Struggle for Vimy Ridge, near Verdun.
31. Naval battle of Jutland begins.

June
1. British defeat Germans in battle of Jutland.
5. British ship *Hampshire* sunk off Orkney Islands, Lord Kitchener on board.
7. Germans take Fort Vaux, Verdun.
10. Austrians defeated by Russians near Czernowitz.
16. Germans push within four miles of Verdun.
17. Russians recapture Czernowitz.
21. Arabs capture Mecca, Jidda, and Taif from Turkey.
23. Fall of Thiaumont and Fleury, France, to the Germans.
24. Russians again hold most of Bucovina.
29. Russians take Kolomea, Galicia.

July
1. Allied offensive on Somme River diverts fighting from Verdun.
19. Russians cross Carpathian Mountains, threaten Hungary.
23. German line at Riga pierced by Russian offensive.
28. Russians capture Brody, Galicia.

August
3. French recapture Fleury and Thiaumont forts.
9. Italians take Gorizia, north of Trieste.
10. Russians take Stanislav, Galicia.
25. Bulgarians enter Kavalla Forts, Macedonia.
27. War declared by Rumania on Austria and by Italy on Germany.
28. Germany declares war on Rumania; fighting begins on Transylvanian front.
30. Rumanians drive Austrians out of Kronstadt; Turkey declares war on Rumania.

September
4. Dar-es-Salaam, German East Africa, surrenders to British.
12. French advance on Somme River.

October
7. German submarine U-53 reaches Newport, Rhode Island.
8. U-53 torpedoes five ships outside of Nantucket; Austrians and Germans retake Kronstadt; Rumanians retreat.
10. Italians take Carso heights, north of Trieste.
11. Greek fleet surrenders to Allies; Austro-Germans invade Rumania.
23. Rumanians lose Constanta, Black Sea port.

November
2. Germans evacuate Fort Vaux, France.
4. Russian navy bombards Constanta.
15. British victory on Ancre River, France, captures Beaumont-Hamel.
18. End of battle of the Somme River.
24. Hospital ship (British) *Braemar Castle* sunk in Aegean Sea.

December
6. Germans take Bucharest, Rumania.
8. Allies blockade Greece.
15. French victory at Verdun.
16. Marshal Joffre retires, succeeded by General Nivelle as commander in chief.
21. British take El Arish, Sinai Peninsula.

1917

January
1. British transport *Ivernia* sunk by submarine in Mediterranean Sea.
5. Russian offensive near Riga.

February
1. Russian lines broken at Halicz.
14. British drive through to third German line near Arras, France.
22. Seven Dutch ships torpedoed and three sunk outside Falmouth, England.

March
5. Germans drive on Verdun.
8. Russian Revolution begins with workers' strikes.
9. Revolts in Petrograd, Russia.
11. Baghdad, Turkey, falls to British.
12. French victories in Champagne area.
15. Russian government overthrown; Czar Nicholas II resigns.
17. British take Bapaume, France.
19. Allies drive on Hindenburg Line, Western Front.

April
2. American armed liner *Aztec* torpedoed off French coast.
3. Germans retreat to Hindenburg Line.
6. United States declares war on Germany; second battle of Aisne River begins.
8. Cuba declares war on Germany.
9. Panama declares war on Germany; allied offensive opens battle of Arras.
10. British hospital ships *Donegal* and *Lanfranc* sunk; Allies take Vimy Ridge.
23. British take Samarra station, north of Baghdad.
28. Battle of Scarpe River, France.

May
4. Disorganization of Russian army.
12. Zeebrugge, Belgian port, bombarded by Allies.
16. General Pétain succeeds General Nivelle as commander in chief of allied troops in France; Kerensky becomes minister of war in Russia.

June
4. Italians proclaim Albania independent state under Italian protection.
7. Fight for Messines Ridge, France.
12. Abdication of pro-German king of Greece.
17. Russian offensive in Galicia; Brusilov, commander in chief of Russians.
29. General Allenby takes command of British in Palestine.

July
1. Russians advance on Lemberg.
2. Greece declares war on Central Powers.
5. German counteroffensive on Aisne River.
16. Kerensky becomes premier of Russia.
22. Siam declares war on Central Powers.
24. Germans take Tarnopol, Russian Poland; Russo-Rumanian attacks fail.
27. British and French cross Yser Canal, Belgium.
31. Allied offensive opens third battle of Ypres.

August
3. Russians retreat from Bucovina, abandon Czernowitz.
4. Liberia declares war on Germany.
14. China declares war on Germany and Austria.
17. Germans fire on Saint-Quentin Cathedral, France.
21. Germans attack near Riga, cross Dvina River.
24. French take hill 304, Verdun.

September
2. Russians retreat from Riga.
3. Germans capture Riga.
8. French capture Chaume Wood, Verdun.
20. Battle of the Menin Road, France.
28. British defeat Turks at Ramadi, on Euphrates River.

October
4. Battle of Broodseinde Ridge.
16. British destroyers *Mary Rose* and *Strongbow* sunk by Germans off Shetland Islands.
17. American transport *Antilles* torpedoed.
24. Italian lines broken in battle of Caporetto, and start retreat to Piave River.

(Continued on the next page)

27. Brazil declares war on Germany; Italians lose Gorizia.
31. British take Beersheba, Palestine.

November
2. British navy sinks German ship *Marie* and ten patrol boats in the Cattegat, between Baltic and North Seas.
7. British take Gaza, Palestine.
8. Bolsheviki overthrow Kerensky.
17. British take Jaffa, evacuated by Turks.
20. British attack Germans at Cambrai, France.
23. Austro-Germans checked in advances in Italy.

December
1. Allies take German East Africa; Allies retreat from Cambrai, France.
7. United States declares war on Austria-Hungary.
9. British take Jerusalem, Palestine.
10. Panama declares war on Austria-Hungary; Italian cruiser torpedoes Austrian ship *Wien* in harbor of Trieste.
22. Russians begin peace negotiations with Central Powers at Brest-Litovsk.

1918

January
6. Armistice on Eastern Front.
7. German sailors mutiny at Kiel.
8. President Wilson of United States presents his "Fourteen Points."
10. Mutiny of Russian Black Sea fleet.

February
1. Russian Ukrainian Republic recognized by Central Powers.
9. Peace treaty signed at Brest-Litovsk between Ukrainians and Central Powers.
10. Russia announces its withdrawal from the war.
18. Germany reopens war against Russians.
20. British take Khan Abu Rayot, north of Ramadi.
21. British take Jericho, Palestine.
24. Turkey takes Trebizond, on Black Sea.
25. Germans take Reval, on Gulf of Finland.

March
3. Bolsheviki sign peace treaty at Brest-Litovsk with Central Powers; peace negotiations begin between Rumania and Central Powers.
9. British take Hit, on Euphrates River.
11. Turks take Erzurum.
13. Germans enter Odessa, Russia, on the Black Sea.
19. Allies protest Russo-German peace treaty.
21. German offensive on Somme River, at Saint-Quentin (battle of Picardy).
24. Germans retake Bapaume and Péronne, France.

April
5. Japanese and British Marines land in Vladivostok, Russia, on Sea of Japan.
6. German offensive on Somme River dies down.
11. Germans take Armentières, France.
14. General Foch becomes commander in chief of allied forces in France.
22. British navy blocks harbors at Zeebrugge and Ostend, Belgium.
25. Guatemala declares war on Germany.
26. Germans take Kemmel Hill, Flanders.
27. Kifri, north of Baghdad, taken by British.
30. Germans enter Vyborg, Russia (north of Petrograd).

May
1. Germans occupy Sevastopol, and find Russian Black Sea fleet.
7. Nicaragua declares war on Germany; Germany and Rumania sign peace treaty at Bucharest, Rumania.
25. Costa Rica declares war on Germany.
27. German offensive on Aisne River.
29. Germans capture Soissons.
30. Germans advance within two miles of Reims, France.

WORLD WAR I CHRONOLOGY—*Concluded*

31. American transport *President Lincoln* sunk.

June
1. Germans take Neuilly Heights and reach Château-Thierry, France.
6. German offensive on Aisne River ends.
11. Allied counteroffensive from Montdidier and Noyon, France.
14. Turks occupy Tabriz, Persia.

July
1. Fort Vaux reoccupied by Allies.
7. British air raid on Constantinople.
11. American ship *Westover* sunk by submarine.
15. Haiti declares war on Germany; German offensive west of Reims begins second battle of the Marne.
18. End of second battle of the Marne; Germans driven back.
19. Honduras declares war on Germany; American cruiser *San Diego* sunk off Fire Island.
21. Allies retake Château-Thierry.

August
2. Germans retreat from Soissons.
3. Allies advance to Aisne and Vesle rivers on 30-mile front in France.
7. German sailors mutiny at Wilhelmshaven.
8. Allied offensive on the Somme River.
15. Allies move 100 miles from Archangel, Russia, along Vologda Railway line.
29. Allies take Bapaume and Noyon, France.
30. Germans retreat in Flanders.
31. Kemmel Hill retaken by Allies.

September
1. Péronne retaken by Allies.
3. Germans retreat from Scarpe River, France.
13. Americans eliminate Saint-Mihiel salient; Verdun-Toul Railway open to Allies.
15. British defeat first and second Bulgar lines in Macedonia.
19. British break Turkish lines in Palestine.
22. British advance beyond Nazareth, Palestine.
23. French capture Prilet, Macedonia; Allies pursue Bulgarian retreat to Doiran Area.
25. Bulgarians seek armistice.
26. Allies attack Germans in Argonne, France.
29. Allies break Hindenburg Line.
30. Bulgaria surrenders.

October
1. French take Saint-Quentin; Damascus taken by British.
2. Serbs enter Nis, Serbia.
5. First peace note sent by Germans to President Wilson; King Ferdinand of Bulgaria abdicates.
6. Americans take Saint-Étienne, France; Le Cateau evacuated by Germans.
8. President Wilson replies to German peace note by requesting withdrawal of German forces from all foreign soil.
9. Cambrai and Roncroi, France, taken by Allies.
12. Germany sends second peace note to President Wilson.
13. Tripoli, North Africa, occupied by British.
14. President Wilson in reply to peace note demands that inhumane practices stop and that Germany change its form of government; Italians take Durazzo, Albania.
15. Czech revolution breaks out in Austria.
17. Ostend, Bruges, and Lille recaptured by Allies on Western Front.
26. Aleppo, Turkey, occupied by British.
27. British and Italians advance across Piave River in battle of Vittorio-Veneto.
30. Entire Turkish forces on Tigris River surrender to British.
31. Turkey signs armistice.

November
2. Italians invade Austria.
3. Italians take Trent; Serbians reoccupy Belgrade, Serbia.
4. Valenciennes taken by British in battle of Samhre; Austrians accept truce terms.
7. Americans take Sedan, cutting one main German line of communication; German seamen revolt at Kiel and Hamburg; German navy in control of revolutionaries.
10. German Emperor William II flees to Holland; British advance in Belgium to Mons Canal area.
11. Germany signs armistice, hostilities cease 11:00 A.M.
21. German fleet surrenders to the British.
25. Surrender of last German forces in East Africa.

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WORLD WAR II CHRONOLOGY*

1939

September
1. Germany invades Poland, starting war.
3. Britain, France, Australia, New Zealand declare war.
8. President Roosevelt issues Emergency Proclamation, authorizing expansion of Army and National Guard.
10. Canada declares war on Germany.
17. Russia occupies east Poland.
27. Warsaw surrenders to Germans.
28. Germany and Russia agree to partition Poland.
29. Estonia forced to accept Russian military protection.

October
2. Pan-American Conference sets up "safety zone" extending 300 miles from coasts of all American Republics.
5. Latvia forced to accept Russian military protection.
10. Lithuania forced to accept Russian military protection.
14. Russia demands bases from Finland. U-boat sinks British battleship *Royal Oak* in Scapa Flow harbor.
19. Turkey signs mutual aid pact with France, Britain.

November
4. Roosevelt signs Neutrality Act, repealing arms embargo.
8. Hitler escapes bomb at Nazi rally in Munich beer hall.
30. Russia invades Finland in undeclared war.

December
2. Russia captures Petsamo, Finnish nickel port.
10. Russia attacks Finnish Mannerheim Line.
14–Jan. 7. Finns defeat Russians at Salla and Suomussalmi.
17. German crew scuttles *Admiral Graf Spee* after 3 British cruisers force it into harbor at Montevideo, Uruguay. First Canadian troops land in England.

1940

February
12. First Australian troops land in Egypt.

March
2. Russians crack Mannerheim Line, seize Vyborg (Viipuri).
12. Finland signs peace treaty with Russia.

April
9. Germany occupies Denmark, invades Norway.
14. First of 12,000 Allied troops land in Namsos, Norway.

May
1-3. Allies evacuate all Norway but Narvik, King Haakon escapes to London.
10. British troops land in Iceland. Germany invades Belgium, the Netherlands, Luxemburg. Churchill succeeds Chamberlain as British prime minister.
11. Nazi paratroops seize "impregnable" Eben Emael fortress.
14. The Netherlands government surrenders. Queen Wilhelmina of Netherlands escapes to London. Dutch casualties, about 10,000. Rotterdam bombed. Nazis take Sedan, opening the battle of the Meuse.
17. Germans take Louvain and Brussels.
19. Gen. Gamelin succeeded by Gen. Weygand as Allied commander in chief.
20. British begin retreat through Belgian ports.
21. Germans reach French coast at Abbeville.
28. King Leopold surrenders Belgium's army of 500,000.
29–June 4. British Expeditionary Force plus thousands of French troops evacuated from Dunkirk.

June
5. Battle of France begins at the Somme.
9. Norway surrenders, British withdraw from Narvik.
10. Italy declares war on France and Britain.
14. Germans enter Paris. Spain occupies Tangier.
16. Marshall Pétain succeeds Paul Reynaud as French premier.
17. Pétain asks Germany for armistice terms for France.
22. France signs armistice with Germany.
24. France signs armistice with Italy.
27. Rumania cedes Bessarabia, northern Bucovina to Russia.

July
3. British attack French fleet at Oran, Algeria.
11. Pétain becomes dictator of France.

August
3. Lithuania annexed as Soviet republic by Russia.
5. Latvia annexed as Soviet republic by Russia.
6. Estonia annexed as Soviet republic by Russia.
8. Germany launches all-out air "blitz" on England.
9. Britain recalls troops from Shanghai and North China.
19. Italy occupies British Somaliland.
21. Rumania cedes southern Dobruja to Bulgaria.
22. United States, Canada name joint defense board.
25. British planes first bomb Berlin.
30. Rumania cedes northern Transylvania to Hungary.

September
3. United States trades Britain 50 destroyers for Atlantic bases.
12. Italy begins invasion of Egypt.
16. Roosevelt signs Burke-Wadsworth Compulsory Military Service Act. First increment of National Guard called to active duty.
22. France grants Indo-China bases to Japan.
25. Germany installs Vidkun Quisling as Norwegian premier.
26. United States limits scrap iron and steel exports to Western Hemisphere and Britain only.
27. Japan joins Rome-Berlin Axis.

October
6. Germany abandons large-scale daylight raids on England; turns to night bombing.
10. Germany occupies Rumania.
16. United States men register in first peacetime draft.
27. De Gaulle establishes "Free French" government.
28. Italy invades Greece.
29. Selection of American draftees begins.

November
11–12. British planes cripple Italian fleet at Taranto.
20. Hungary joins Axis.
23. Rumania joins Axis.

December
6. Greeks rout Italians from Portu Edda, Albania.
9. British strike back at Italians in Egypt.

1941

January
20. British attack Italians in Eritrea.

February
5. British drive Italians from the Sudan.

March
1. German-occupied Bulgaria joins Axis.
7. British win Italian Somaliland.
11. Roosevelt signs Lend-Lease Act. French Indo-China cedes territory to Siam.
25. Yugoslavia joins Axis.
28. British sink 5 Italian warships off Cape Matapan.
30. United States seizes Axis ships in American ports.

April
3. British yield Bengasi, Libya, to Axis attack.
6. Germany attacks Yugoslavia, Greece. British take Addis Ababa, Ethiopian capital.
9. United States takes Greenland under protection.
12. British lose Bardia, Libya.
17. Yugoslav army surrenders.
18. Britain occupies Iraq.
27. Germans occupy Athens.
30. British forces leave Greece.

*All dates for the Pacific war are given as of the area where the action occurred.

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WORLD WAR II CHRONOLOGY*—*Continued*

May
10. Hess flies to Scotland, interned by British.
16. Iceland ends Union with Denmark.
19. British complete liberation of Ethiopia.
20. German paratroops invade Crete.
21. U-boat sinks American freighter *Robin Moor* in Atlantic.
24. German *Bismarck* sinks British *Hood*.
27. British fleet and air units sink *Bismarck*.

June
1. British evacuate Crete.
8. British and Free French invade Syria.
14. United States "freezes" German and Italian assets in America.
22. Germany invades Russia. Italy declares war on Russia.
26. Finland enters war against Russia.

July
7. United States occupies Iceland, as requested July 1 by the government of Iceland.
14. British occupy Syria; Vichy French sign armistice.
21. French give military control of Indo-China to Japan.
25. United States and Britain "freeze" Japanese assets.

August
1. United States bans gasoline export to Japan.
6. Germans capture Smolensk, Russia.
14. Roosevelt, Churchill announce Atlantic Charter.
25. Britain, Russia occupy Iran to prevent Nazi coup.

September
11. Roosevelt orders Navy to fire on Axis raiders in American defense zones.
19. Germans enter Kiev, Russia.
29. United States pledges matériel to Russia.

October
9. Turkey signs trade treaty with Germany.
11. U.S. Navy announces capture of German radio station in Greenland.
16. Germans take Odessa.
18. Tojo appointed premier of Japan.
19. Moscow declares state of siege.
24. Kharkov falls to Germans.
31. U-boats sink United States destroyer *Reuben James* off Iceland.

November
17. Neutrality Act amended to arm American merchant ships.
20. Japanese envoys submit "last proposals" to United States.
22. Germans take Rostov, key to Caucasus.
26. United States proposes economic cooperation to Japan.
29. Russians recapture Rostov, take offensive in Ukraine.

December
6. Roosevelt appeals to Hirohito to intervene for peace.
7. Japanese attack Pearl Harbor and Midway. Canada declares war on Japan. On same day (Dec. 8, Far Eastern time), Japanese strike at Wake, Guam, Philippines, British Malaya, Hong Kong; invade Siam. Netherlands Indies declares war on Japan.
8. United States, Britain declare war on Japan.
9. China declares war on Japan, Germany, Italy. Siam surrenders to Japan.
10. Japanese planes sink British ships *Prince of Wales* and *Repulse* off Malaya. Japanese land on Luzon in the Philippines.
11. United States declares war on Germany, Italy. Germany, Italy declare war on United States. Japanese occupy Guam.
12. Japanese invade Burma from Siam.
16. Japanese invade Borneo.
19. Hitler takes personal command of German army.
22. Churchill discusses united war effort with Roosevelt.
23. Wake Island surrenders to Japanese.
25. Hong Kong falls to Japanese.

1942

January
1. Twenty-six nations sign United Nations Pact.
2. Japanese enter Manila, occupy Cavite naval base.
10. Japanese invade Netherlands Indies at Tarakan.
13. United States creates War Production Board.
21. Rommel's *Afrika Korps* advances into Cyrenaica.
23. Japanese capture Rabaul on New Britain; invade New Ireland and the Solomons.
23–24. United States warships attack Japanese forces in Makassar Strait.
26. First A.E.F. since 1918 lands in Ireland.
28. Inter-American conference at Rio de Janeiro affirms solidarity.
29. *Afrika Korps* takes Bengasi, Libya, after 200-mile drive. Iran signs co-operation pact with Russia, Britain.
31. Siege of Singapore begins. British evacuate Moulmein, Burma.

February
1. U.S. Navy raids Gilbert and Marshall Islands.
14. Japanese occupy ports in southern Borneo, invade Sumatra.
15. Singapore falls to Japanese.
19. Japanese invade Bali in East Indies. Japanese planes bomb Port Darwin, Australia.
24. United States naval task force bombards Wake Island.
27–Mar. 1. Japanese overwhelm Allied naval forces in battle of Java Sea.
28. Japanese land in northern Java.

March
4. United States Navy raids Marcus Island.
8. Japanese invade New Guinea, landing at Salamaua and Lae.
9. Rangoon, capital of Burma, falls. Japanese conquest of Java completed.
12. American troops land in New Caledonia.
17. MacArthur reaches Australia from Philippines, assumes command of United Nations' forces in Southwest Pacific.
23. Japan occupies Andaman Islands in Bay of Bengal.
28. British Commandos raid U-boat base at St. Nazaire. United States national debt raised to $125,000,000,000.

April
9. Bataan peninsula falls after 98-day siege.
11. India refuses dominion status; asks immediate liberty.
18. Doolittle leads B-25 bombers from *Hornet* to raid Tokyo, Yokohama, Nagoya.
22. British Commandos raid Boulogne.
29. Japanese capture Lashio on Burma Road.

May
1. Mandalay falls to Japanese.
4–8. United States Navy defeats Japanese invasion fleet in battle of Coral Sea.
6. Corregidor falls.
8. Nazis open spring offensive in Crimea.
12. Russia counterattacks on Kharkov front.
14. WAAC law creates Women's Army Auxiliary Corps.
15. Japanese gain virtually undisputed possession of Burma.
22. Mexico declares war on Axis.
24. Russians evacuate Kerch Peninsula in East Crimea.
30. British send 1,000-bomber flight to destroy Cologne.

June
3. Japanese bomb Dutch Harbor.
3–6. United States Navy defeats Japanese, battle of Midway.
4–6. Japanese invade Aleutian Islands.
10. Nazis announce razing of Lidice in reprisal for assassination of Heydrich, German governor of Czechoslovakia.
21. Nazis take Tobruk. Japanese submarine shells seaside, on Oregon coast.
25. Germans penetrate Egypt. Eisenhower lands in London.
27. FBI completes capture of 8 Nazi saboteurs landed by U-boat.

July
1. British 8th Army stems Rommel's drive at El Alamein. Sevastopol falls to Germans after 25-day siege.
4. First United States fliers raid Europe.
14. "Free French" change name to "Fighting French."
21–22. Japanese land at Gona, Buna in New Guinea.
27. Russians evacuate Rostov as Nazis drive toward Caucasus.
30. United States Navy establishes the WAVES.

August
7. United States Marines land on Guadalcanal, Tulagi.
9. Japanese naval force sinks 1 Australian and 3 American cruisers at battle of Savo Island, fails to press advantage.
17. United States Marines raid Makin Island.
19. British-Canadian Commandos, American Rangers raid Dieppe.
22. Brazil declares war on Axis.
24. Nazis advance on Stalingrad.
26. American bombers raid Lashio in Burma.
30. Germany annexes Luxemburg.

September
9. Incendiary bomb found in Oregon, believed to be Japanese.
11. Nazis take naval base at Novorossisk on Black Sea.
14. United States bombers make first major raid on Kiska.
28. Allies drive Japanese back in New Guinea.

October
1. United States rations fuel oil.
11–12. Japanese lose 4 ships at battle of Cape Esperance.
13. United States Army troops join Marines on Guadalcanal.
23. British open assault against *Afrika Korps* at El Alamein.

November
6. Rommel's *Afrika Korps* retreats.
8. American forces invade North Africa.
11. Hitler occupies "unoccupied" France.
13–15. American Navy defeats Japanese off Guadalcanal.
14. Allied troops enter Tunisia.
20. Alaska Military Highway (Alcan) opens.
27. French scuttle fleet at Toulon to prevent Axis seizure.

December
1. Darlan assumes authority over French North Africa. United States rations gasoline nationally.
9. Allies take Gona on northern coast of Papua, New Guinea.
14. Americans, Australians take Buna village, New Guinea.
16. British, under Wavell, begin invasion of Burma.
24. Darlan assassinated in Algiers.

1943

January
1. Russians recapture Velikie Luki.
6. United States makes first daylight raid on Rabaul.
18. Russian army lifts siege of Leningrad.
22. Papuan Campaign completed with end of resistance in Sanananda area.
23. British take Tripoli, Rommel in retreat.
26. Casablanca conference announces demand for "unconditional surrender."

*All dates for the Pacific war are given as of the area where the action occurred.

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WORLD WAR II CHRONOLOGY*—*Continued*

February
2. Russians defeat Nazis at Stalingrad.
6. Creation of U.S. North African theater under command of Eisenhower announced.
8. United States forces completely occupy Guadalcanal.
14. Russian army recaptures Rostov.
16. Russian army recaptures Kharkov.
21. Allies evacuate Kasserine Pass in Tunisia.
25. *Allies recapture Kasserine Pass.*

March
2–4. Allies bomb Japanese convoy in Bismarck Sea.
10. Fourteenth Air Force set up in China under Chennault.
14. Germans recapture Kharkov.
28. British break German Mareth Line in Tunisia.

April
7. British and American forces join in Tunisia.

May
7. Announce American troops occupy Adak, Amchitka. Allies capture Tunis and Bizerte.
11. American forces invade Attu in Aleutian Islands.
12. German resistance ends in North Africa.
30. Americans conquer Attu.

June
3. De Gaulle forms French Committee of National Liberation.
11. Allies take Pantelleria after "saturation" bombing started May 9.
17–18. American planes from Funafuti bomb Tarawa.
30. Allies land on Rendova in New Georgia group.

July
2–3. Americans land on New Georgia.
6. United States Navy victorious in Kula Gulf.
9–10. Allies invade Sicily.
25. Mussolini succeeded by Badoglio.
29. Eisenhower broadcasts peace offer to Italy.

August
1. U.S. planes bomb Ploesti oil fields.
5. British enter Catania in Sicily. Americans take Munda on New Georgia Island.
15. Americans-Canadians land on deserted Kiska.
17. Americans take Messina to end Sicily campaign. American bombers make first "shuttle" raid from England over Germany and on to North Africa.
17–24. Roosevelt and Churchill confer in Quebec, Canada.
19. Allied air raid smashes Foggia, German air base in Italy.
25. Japanese evacuate New Georgia.

September
3. Allies invade southern Italy, receive Italian surrender effective 5 days later.
4. American Marines invade Nanumea in Ellice group.
4–16. Allied forces encircle and recapture Lae-Salamaua area in New Guinea.
8. Russians take Stalino in Donets basin.
9. British take Taranto naval base at tip of southern Italy. American 5th Army invades Italy at Salerno.
10. Germans seize Rome, assure "protection" of Vatican.
16. British 8th Army joins American 5th Army at Salerno. Russians capture naval base at Novorossisk.
22. Australian troops land north of Finschhafen, New Guinea.
25. Nazis evacuate Smolensk.
27. Allies capture Foggia air base.

October
1. Allies take Naples; Germans retreat north to Volturno River.
2. MacArthur's forces capture Finschhafen after 10-day campaign.
12. Portugal opens Azores bases to the Allies.
13. Italy declares war on Germany.
18. Allies force Nazis from Volturno line.

November
1. *United States Marines invade Bougainville.*
6. Russian army liberates Kiev in midst of winter offensive.
21. U.S. forces invade Gilbert Islands, Marines landing on Tarawa and Infantry on Makin.
22. Roosevelt, Churchill, Chiang Kai-shek open Cairo talks; finish November 26.
24. Americans conquer Tarawa and other key Gilbert Islands.
28. Roosevelt, Churchill, Stalin open Tehran conference; agree on final plans to defeat Germany; conclude talks December 1.

December
15. American soldiers land at Arawe, New Britain.
26. Marines land at Cape Gloucester, New Britain.

1944

January
4. Russians cross 1939 Polish border.
12. Allies begin attack on Cassino.
19. Russians cut German lines in north around Leningrad.
20. Allies attack along Rapido River in Italy in move to drive Germans from Gustav Line.
22. Allies land at Anzio beachhead; withdraw to left bank of Rapido River.
27. Allies cross Rapido under heavy fire.

February
1. Army, Marines land on Kwajalein.
5. Americans complete capture of Kwajalein.
15. American planes bomb Ponape, 400 miles east of Truk.
17–18. United States Navy task force bombs and shells Truk.
22. Americans complete capture of Eniwetok in Marshall Islands. Russians capture Krivoi Rog, important iron center.
29. MacArthur's forces invade Admiralty Islands.

March
5. Allied paratroops land behind enemy lines in Burma.
7. First U. S. troops fight in Asia, help Chinese seize Walawbum in Burma. Japanese invade India on Manipur plain near Imphal.
20. Germans begin military occupation of Hungary. MacArthur's forces take Admiralty Islands.
30–31. U.S. Naval force raids Palau islands; hits airfields, mines surrounding waters.

April
3. American forces occupy Bikini and other Marshall atolls.
10. Russians take port of Odessa on Black Sea.
22. Americans invade Hollandia in north New Guinea.

May
9. Russians recapture Sevastopol after 24-day siege.
11. Allies break through German line south of Cassino.
17. Merrill's Marauders take Myitkyina airfield, Burma.
17–19. U.S. troops occupy Wakde Islands area, New Guinea.
18. Allies capture Cassino.

June
4. American 5th Army enters Rome.
5. King Victor Emmanuel of Italy transfers royal power to his son, Humbert, as Lieutenant General of the Realm.
6. Allies invade France at Normandy coast.
13. Germans launch robot bombs on southern England.
15. United States Marines invade Saipan in the Marianas.
16. *China-based B-29's raid southern Japan.*
19–20. American naval planes rout Japanese fleet in battle of the Philippine Sea.
25. Americans enter Cherbourg; entire Cherbourg peninsula captured July 1.
28. Japanese take Hengyang airfield, American air base, China. U.S. forces end organized resistance on island of Biak northwest of New Guinea.

July
2. U.S. forces invade Noemfoor, Dutch New Guinea.
3. Russians win Minsk, capital of White Russia.
9. Japanese resistance on Saipan broken. British-Canadian forces capture Caen.
18. American forces capture St. Lô, Normandy. Hirohito ousts Tojo.
19. Americans enter Livorno.
20. Hitler injured by bomb in assassination attempt.
21. American Marines invade Guam.
23. Americans enter Pisa.
24. U. S. Marines land on Tinian. Russians take Lublin, Polish rail center.
30 Allies land at Cape Sansapor, Dutch New Guinea.
31. Americans take Avranches to complete Normandy break-through.

August
1. Japanese resistance ceases on Tinian.
2. Turkey severs relations with Germany.
3. Americans, Chinese take north Burma base of Myitkyina.
4. Russians penetrate to outskirts of Warsaw. Patton's troops take Rennes, chief city of Brittany.
10. Organized resistance on Guam ceases.
15. Allied armies invade southern France from the sea.
17. General Patton's forces take Chartres. Americans-Canadians converge on Falaise "pocket" (closing it August 20, ending battle of Normandy). British announce retreat of Japanese from frontier of India.
19. People of Paris and Underground attack German army.
20. American advance patrols enter Versailles.
21. French troops take Toulon; Dumbarton Oaks Conference opens in Washington, D. C.
22. Germans leave Florence, retire to Gothic Line.
23. King Michael orders Rumanian army to cease fire.
24. French troops enter Paris.
25. Americans march into Paris. Finland asks Russia for armistice.
28. Russians enter Transylvania region of Hungary. Americans enter Soissons.
29–31. Americans enter Reims, Nice, Verdun.
31. Russians enter Bucharest, drive Germans from Ploesti oil fields.

September
2. Hodges' 1st Army crosses into Belgium.
3. British take Brussels.
4. Finland ends war on Russia. Allies take Antwerp.
5. Russia declares war on Bulgaria.
6. Russians reach Yugoslav border at Turnu Severin.
8. Russians cross Danube River, enter Bulgaria. Allies take Liége.
9. Russia grants armistice to Bulgaria.

*All dates for the Pacific war are given as of the area where the action occurred.

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WORLD WAR II CHRONOLOGY*—*Concluded*

11. Roosevelt, Churchill begin Quebec Conference, ending Sept. 16. American 1st Army crosses German border east of Aachen. Allies penetrate the Netherlands. U.S. 7th and 3d Army patrols meet west of Dijon.
12. Le Havre surrenders.
15. Marines invade Peleliu in the Palaus; land on Morotai Island; Americans breach Siegfried Line east of Aachen.
17. Nazis pocket Allied air-borne landings at Arnheim.
18. Brest surrenders.
19. Finland signs armistice with Russia.
20. Allies capture Nijmegen bridge.
22. Russians capture Tallinn, capital and naval base of Estonia.
23. British air-borne troops invade Greece. U.S. forces take Ulithi in Carolines without opposition.
26. Air-borne Allies surrender in Arnheim trap.
27. Allies announce landings in Albania.
28. Russians enter Czechoslovakia.

October
11. Americans enter Aachen suburbs. City falls October 21. Germans declare Athens an open city.
16. Partisans, Russian forces enter Belgrade; capture it October 20.
20. Americans begin Philippine campaign, invade Leyte.
23. United States, Britain, Russia recognize de Gaulle Government.
23–26. American Navy defeats Japanese in Leyte Gulf.

November
1. Liberation of Greece completed.
3 Chinese troops in final assault capture Lungling on Burma Road.
5. Allies bomb Singapore.
7. Americans evacuate Linchow, last major 14th Air Force base in China.
22. American 3d Army takes Metz.
24. B-29's bomb Tokyo in first raid since 1942.
26. First Allied ships unloaded at Antwerp.

December
15. United States forces invade Mindoro in Philippines.
16. Germans counterattack at Ardennes Forest to begin "battle of the Bulge."
20. U. S. 101st Air-borne Division trapped at Bastogne.
26. MacArthur announces end of resistance on Leyte. Russians penetrate Budapest suburbs.
27. Americans take offensive in "battle of the Bulge."

1945

January
9. Americans invade Luzon at Lingayen Gulf.
16. American 1st and 3d Armies meet at Hauffalize, Belgium, after separation by enemy bulge since December 16.
17. Russians take Warsaw.
19. Russians capture Cracow and Lodz.
20. *Hungary signs armistice with Allies.*
28. Ledo-Burma road opened to convoys to China.

February
4. Americans enter Manila.
4–11. Roosevelt, Churchill, Stalin confer at Yalta.
10. Americans take Roer dam at Schwammenauel after Nazis opened sluices.
13. German garrison at Budapest surrenders to Russians.
15. Americans land on Bataan. Land on Corregidor next day.
19. United States Marines land on Iwo Jima.
21–Mar. 8. Twenty American republics meet in Mexico City, hold Inter-American Conference on Problems of War and Peace.
23. Turkey declares war on Germany, Japan. Japanese resistance in Manila ends.
24. Egypt declares war on Germany, Japan.

March
3. Act of Chapultepec signed in Mexico City. Finland declares war on Germany in an act dated March 1.
7. American 1st Army seizes Cologne; crosses Rhine River at Remagen bridge.
14. Russians cross Oder River north of Frankfort.
16. Marines complete conquest of Iwo Jima.
18. American 3d Army takes Rhine city of Coblenz.
21. British take Mandalay.
22–23. Allied troops cross Rhine in force.
27. Argentina declares war on Germany, Japan. Russians penetrate Danzig.

April
1. United States Army, Marines land on Okinawa.
5. Russia cancels 1941 neutrality pact with Japan.
8–13. Russians capture Vienna.
12. President Roosevelt dies.
16. Americans enter Nuremberg. Enter Leipzig next day.
18. Americans cross Czech border. Germany is cut in two.
21. Russians enter Berlin. Allies take Bologna, Italy.
24. United States refuses Himmler's offer to surrender.
25. San Francisco Conference to form United Nations opens. American, Russian patrols meet at Torgau on Elbe River.
26. British 2d Army captures Bremen. Russians take Stettin on the Baltic.
28. Italian partisans execute Mussolini.
29. Germans in northern Italy, southern Austria surrender, but announcement withheld until May 2.

May
1. Hitler reported dead; Doenitz proclaims himself Fuehrer.
2. Berlin surrenders.
3. Hamburg surrenders to British. Rangoon falls to British, virtually ending Burma campaign.
4. Nazis surrender Denmark, Netherlands, all northern Germany to Montgomery.
5. Large German force surrenders to U.S. Sixth Army Group.
7. Germans surrender unconditionally at Reims.
8. Surrender of Germany ratified in Berlin.
23. Heinrich Himmler, German Gestapo chief, commits suicide.

June
21. Americans complete conquest of Okinawa.
26. Fifty nations sign charter of United Nations at San Francisco.
28. MacArthur announces liberation of Luzon.

July
5. United States, Britain recognize provisional Warsaw government. MacArthur announces complete liberation of Philippines.
14. Navy bombards Honshu and Hokkaido.
16. United States Army explodes experimental atomic bomb on New Mexico desert.
17–Aug. 2. Truman, Churchill (later Attlee), Stalin meet at Potsdam, agree to decentralize Germany.

August
2. Japan hit by largest B-29 attack, made by 800 Superforts.
6. American plane drops atomic bomb on Hiroshima.
8. Russia declares war on Japan.
9. Atomic bomb dropped on Nagasaki.
10. Japan sues for peace.
15. Japan accepts Allied surrender terms.
27. American occupation force enters Japan.

September
2. Japan surrenders formally aboard U.S.S. *Missouri* in Tokyo Bay.

*All dates for the Pacific war are given as of the area where the action occurred.

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Writs of assistance
James Otis opposes O-427-8

W. R. N. S., Women's Royal Naval Service (British navy).

Wroclaw, Poland. *See in Index* Breslau

Wrong, George M(cKinnon) (1860-1948), Canadian historian, born Ontario, Canada; professor of history University of Toronto 1894-1927 ('The Conquest of New France'; 'Washington and His Comrades in Arms').

Wrought iron I-242, 246

Wrymouth, or **ghostfish**, large fish of the North Atlantic and Pacific (*Cryptacanthodes maculatus*) resembling blennies but with mouth set almost vertically.

Wryneck, birds of the woodpecker family which writhe the head and neck when disturbed. Common species of Great Britain and Europe (*Jynx torquilla*) somewhat larger than sparrow, rusty ash color, spotted brown and black.

Wuchang, China, capital of Hupeh province; on Yangtze River opposite Hankow; pop. 199,012; with Hankow and Hanyang forms important commercial center: *maps* C-260, A-406

Wuchow (*wụ'gō*), China, treaty port on Si Kiang 125 mi. w. of Canton; pop. 206,986; distributing point for 3 provinces: *maps* C-260, A-407

Wu-Han, triple city of Hankow, Hanyang, Wuchang, China H-259

Wulf'enite, a mineral, lead molybdate, crystallizing in tetragonal system; bright luster, gray to yellow or red in color; a source of molybdenum; found in Arizona and in province of Carinthia, Austria: *color picture* M-264

Willpelsberg (*vĭl'pĕls-bĕrк*), peak in n. Switzerland; castle original seat of Hapsburgs: H-261

Wundt (*vụnt*), **Wilhelm** (1832-1920), German physiologist, psychologist, and philosopher; called creator of experimental psychology ('Principles of Physiological Psychology'): P-426, M-261

Wupatki National Monument, in Arizona N-38*c*, *map* N-18

Wu Pei-fu (*wọ pā'fọ*) (1873-1939), Chinese poet and general.

Wuppertal (*vọp'ĕr-tăl*), city in w. Germany, on Wupper River; formed in 1930 by union of Barmen and Elberfeld; pop. 363,224; manufacturing: *maps* E-424, *inset* G-88

Wurdemann, Audrey May (born 1911), poet, born Seattle, Wash.; married to poet Joseph Auslander 1933; poems marked by skilled craftsmanship ('The House of Silk'; 'Bright Ambush', Pulitzer prize 1935; and 'Splendour in the Grass').

Würm, a glacial phase I-5

Württemberg (*vür'tĕm-bĕrк*), former state in s.w. Germany; made duchy 1495 by Emperor Maximilian; 1806 made a kingdom by Napoleon; 1871 became kingdom in German Empire; area was 7532 sq. mi.: *map* E-425

Württemberg-Baden, former state in American zone, Germany; created, after World War II, from part of former states of Württemberg and Baden; area, 6064 sq. mi.; pop. 3,-907,848; merged by plebiscite 1951 with former states of South Baden and Württemberg-Hohenzollern to form the new state Württemberg-Baden (Baden-Württemberg); cap. Stuttgart: *map* G-88

Württemberg-Hohenzollern, former state in French zone, Germany; created after World War II, from part of former state of Württemberg and district of Hohenzollern; area, 4018 sq. mi.; pop. 1,242,204; since 1951, part of Württemberg-Baden.

Wurtzilite (*wûrts'ĭ-līt*), a type of asphalt A-424

Würzburg (*vürts'bụrк*), Germany, city of Bavaria on Main River 60 mi. s.e. of Frankfort; pop. 78,443; chemical manufactures; university founded 1582: *maps* G-88, E-425

Wu Tao-tzu (*wọ'dou'dzŭ'*) (born about A.D. 700), celebrated Chinese fresco painter C-277

'Wuthering Heights', tragic novel by Emily Brontë (1847); story built around Heathcliff, the hero, who was found and adopted by Mr. Earnshaw, owner of Wuthering Heights; intense love, hate, cruelty, and suffering are starkly portrayed: B-328

Wu Wang, first Chinese emperor of the Chou Dynasty
founded earliest known zoological garden: Z-359

Wyandot Indians, or **Wyandotte**. *See in Index* Huron

Wy'andotte, Mich., city 10 mi. s.w. of Detroit on Detroit River; pop. 36,846; chemicals, salt, limestone, stoves, iron products: *map*, *inset* M-227

Wyandotte, a breed of poultry P-402*b*, *picture* P-402*a*

Wyandotte Cave, in Indiana, great cave in s., 5 mi. n.e. of Leavenworth; noted for number and variety of stalactites and stalagmites: *map* I-72

Wy'ant, Alexander Helwig (1836-92), American landscape painter, born Tuscarawas County, Ohio.

Wy'att, John (1700-1766), English inventor, born near Lichfield, England; first worked as a carpenter; obtained mechanical assistance from Lewis Paul who took out patent for "roller-spinning" in 1738; after 1762 worked at Soho foundry, and invented compound lever and weighing machine: I-131

Wyatt, or **Wyat, Sir Thomas** (1503-42), English poet and statesman, said to have been in love with Anne Boleyn; introduced sonnet into England from Italy; father of **Sir Thomas Wyat the Younger** (1520-54), who was executed for leading "Wyat's rebellion" to prevent Spanish marriage of Queen Mary I: E-376*a*

Wyche, Richard Thomas (1867-1930), storyteller, born Granville County, N.C.; lecturer at University of Chicago and for the Chautauqua Institution; cofounder of *Story Tellers' Magazine* ('Some Great Stories and How to Tell Them'): S-406*a*

Wycherley (*wĭch'ĕr-lĭ*), **William** (1640?-1716), English wit and dramatist ('Love in a Wood'; 'The Plain Dealer'; 'The Country Wife'): D-133

Wycliffe, also **Wyclif, Wickliffe**, or **Wiclif** (*wĭk'-lĭf*), **John** (1320?-84), English churchman and reformer W-314, *picture* R-91
first complete Bible translation in English B-135, W-314
Huss influenced by H-452

Wye (*wī*), a river rising in s. Wales; flows s.e. into Herefordshire, England, and turns s. entering the estuary of the Severn; length 130 mi.; connected by canal with the Severn: *maps* B-321, 325

Wyeth, Nathaniel Jarvis (1802-56), trader and Oregon pioneer, born Cambridge, Mass.; projected great fur and salmon enterprise, and organized two expeditions (1832, 1834); efforts doomed by series of misfortunes and opposition of Hudson's Bay Co., but ventures furthered American claims and aroused Eastern interest.

Wyeth, Newell Converse (1882-1945), artist, born Needham, Mass.; well known for colorful and vivid illustrations for children's classics and for vigorous murals, among which are panels in Missouri State Capitol and in Hubbard Memorial Building, Washington, D.C.
illustrations: 'The Black Arrow', *picture* E-381; 'The Deerslayer', *picture* A-226*b*

Wylie (*wī'lĭ*), **Elinor** (Mrs. William Rose Benét) (1885-1928), poet and novelist, born Rosemont, Pa.; praised for precise style, beautiful imagery ('Nets to Catch the Wind', 'Black Armour', 'Trivial Breath', 'Angels and Earthly Creatures', verse; 'Jennifer Lorn', 'The Venetian Glass Nephew', 'The Orphan Angel', novels of fantasy): A-230*d*
quoted P-334

Wylie, I(da) A(lexa) R(oss) (born 1885), British novelist, born Melbourne, Australia; educated Belgium, England, and Germany ('To the Vanquished'; 'Ho, the Fair Wind'; 'Candles for Therese').

Wylie, Philip Gordon (born 1902), author, newspaper columnist, born Beverly, Mass.; wrote for motion pictures 1931-37 (books on fishing: 'Crunch and Des', short stories, and 'Denizens of the Deep', essays; satire on American behavior: 'Generation of Vipers'; novels: 'Night unto Night', 'Tomorrow!').

Wyman, Jeffries (1814-74), anatomist, born Chelmsford, Mass.; professor

of anatomy, Harvard University, 1847–74; helped to establish anatomical museum there; curator, Peabody Museum, Harvard University, 1866–74.

Wy'nantskill, stream in s.e. New York, about 20 mi. long, flowing into Hudson River at Troy; furnishes water power.

Wynfrith, or **Winfrid**, original name of St. Boniface B-228

Wyoming (*wī-ō'ming*), a Rocky Mountain state of U.S.; 97,914 sq. mi.; pop. 290,529; cap. Cheyenne: W-315–26, *maps* W-322–3, 316, 319, U-252, 296, *pictures* W-315, 320–1, 325–6
- agriculture W-316, 318
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- Capitol, State, *picture* W-325
- cattle ranges C-150, 148, 155, *picture* W-326
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  - Cheyenne C-227–8, *picture* C-228
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  - Shoshone Cavern N.M. N-38*c*
  - Yellowstone N.P. Y-337–9, *maps* Y-338, *pictures* Y-337, 339
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- tree, state W-317

Wyoming, University of, at Laramie, Wyo.; state control; founded 1887; liberal arts, agriculture, commerce and industry, education, engineering, law, music, nursing, pharmacy; graduate school: *picture* W-325

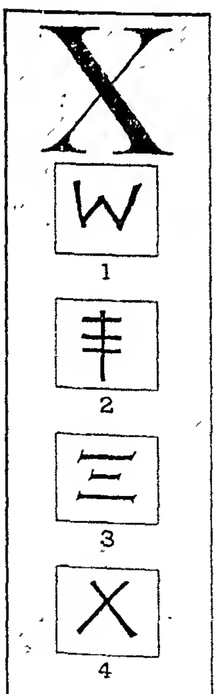
Wyoming Massacre, or battle of Wyoming (1778) P-139

Wyoming Valley, fertile valley of Luzerne County, Pa., along n. branch of Susquehanna River; defeat of Americans by Tories and Indians July 3, 1778
- Connecticut claims C-451: quarrel over ownership W-134
- massacre (1778) P-139

Wyspianski, Stanislaw (1869–1907), Polish painter and dramatist, born Cracow; losing use of hand, turned to writing; voiced national aspirations ('The Wedding').

Wyss (*vīs*), **Johann David** (1743–1818), Swiss writer, born Bern, Switzerland; author of 'The Swiss Family Robinson' and of the Swiss national anthem 'Rufst du, mein Vaterland'.

Wythe, George (1726–1806), jurist, born near Hampton, Va.; as member of Virginia House of Burgesses drew up remonstrance to proposed Stamp Act (1764); signer Declaration of Independence, member Constitutional Convention
- home, interior, *picture* A-193*c*
- Jefferson studied with J-332
- signature reproduced D-37



OUR LETTER X really is a child of S. It was born when the Greeks learned how to write from the Phoenicians.

The new letter got its start because the Phoenicians had two signs, *shin* or *sin* (1), and *samekh* (2), for S, as told in the Fact-Index article on S. But the Greeks wanted only one sign for S, and eventually they chose the *sin* sign. This left the *samekh* sign available for other use, and several different uses for it grew up in Greece.

The eastern or Ionic Greeks used it for the sound which they called *xi* (pronounced 'ksee', with the first consonant sound run rapidly into the second). The sign itself came to be made without an upright stroke (3). The Chalcidian Greeks, who settled in southern Italy, used the same name and pronunciation; but they had come to use the sign for another letter (*chi*). This did not cause difficulty, however, because the Greek sign for T was extremely unlike the old Phoenician cross (4). The Chalcidian colonists therefore used the cross for *xi*.

When the Romans developed their Latin alphabet from the Greek, they took over the new letter and gave it the Chalcidian Greek sign; but they turned the Greek *name* around. Instead of ending the name with the sound of 'i', they placed this sound at the beginning. Thus the name became *iks*. From Latin the sign and the name came into English without change except for a shift from 'i' to 'e' at the start of the name. We call the letter *eks*.

The handwritten small 'x' is simply a capital, somewhat rounded for ease and speed in making; the printed small 'x' often preserves this rounding on one stroke.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Xanadu (*zăn'a-dụ*), in Samuel Taylor Coleridge's poem 'Kubla Khan', an imaginary city; named for a city mentioned in a book by Samuel Purchas. *See also in Index* Purchas, Samuel

Xanthate (*zăn'thāt*) **cellulose** C-162, *table* C-162

Xanthisma (*zăn-thĭz'ma*), a biennial plant of the composite family, native to s.w. U.S. One species (*X. texanum*) grows to 4 ft.; leaves narrow, lance-shaped, about 3 in. long; flowers yellow, daisy-like, solitary on erect stems; also called star of Texas.

Xanthium (*zăn'thĭ-ŭm*), a genus of coarse, annual herbs of the family *Compositae*; stems branching; leaves, toothed or lobed; fruit inclosed in spiny or hooked burs which readily cling to clothing or to the hair and fur of animals; the various species are known as cocklebur, clotbur, or burweed.

Xantippe, or **Xanthippe** (*zăn-tĭp'ē*), Socrates' shrewish wife S-224

Xavier (*zăv'ĭ-ēr*, Spanish *häv-yêr'*), **Saint Francis** (1506–52), Spanish Jesuit missionary X-327, *picture* X-327

Xavier University, at Cincinnati, Ohio; Roman Catholic; for men; founded 1831; arts and sciences, business administration; coeducational in graduate studies.

Xavier University, at New Orleans, La.; Roman Catholic; founded 1915; arts and sciences, education, pharmacy; graduate school.

Xaymaca, Indian name for Jamaica J-290

Xenia, Ohio, city 16 mi. s.e. of Day-

ton in rich farming and stock-raising region; pop. 12,877; binder twine, rope; state school for soldiers' and sailors' orphans; Wilberforce University nearby: *map* O-357

Xenocrates (*zĕ-nŏk'ra-tēz*) (396–314 B.C.), Greek philosopher, pupil and follower of Plato; emphasized ethics in his teaching and writings.

Xenon (*zĕn'ŏn*), a chemical element, *tables* P-151, C-214

Xenophanes (*zē-nŏf'a-nēz*), Greek philosopher and poet of the 6th century B.C.; supposed founder of Eleatic school of philosophy which taught that the law of the universe is fixed and unchanging.

Xenophon (*zĕn'ō-fŏn*) (about 430–355 B.C.), Greek historian and general X-327

Xeranthemum (*zē-răn'thē-mŭm*), a genus of annual plants, of the composite family, native to the Mediterranean region. One of the plants early used as immortelles or everlastings. Flowers solitary, long-stemmed, asterlike, white, lilac, rose, or purple; papery flower heads dry readily: similar to the strawflowers, or helichrysum.

Xeres, Spain. *See in Index* Jerez

Xerography (*zēr-ŏg'ra-fi*), a duplicating process P-414c

Xerophytes (*zē'rō-fits*), plants, such as desert plants, adapted for growth with a limited water supply.

Xerxes (*zûrk'sēz*) **I** (519?–465 B.C.), king of Persia; led expedition against Greece: P-156, P-159
relief portrait at Persepolis, *picture* P-157
stairway to his audience hall, *picture* P-157

Ximénes (*zi-mē'nēz*, Spanish *hē-mā'nāth*), or **Jimenez, de Cisneros, Francisco** (1436–1517), Spanish cardinal X-327–8
Complutensian Polyglot Bible B-137

Xingú (*shing-gō'*) **River**, a large s. tributary of the Amazon, in Brazil; about 1200 mi. long: *maps* B-288, S-252, 256

Xochimilco (*sō-chē-mēl'kō*), **Lake**, near Mexico City; noted for floating vegetable and flower gardens.

X rays, or Roentgen rays X-328–32, R-30f, *pictures* X-328–9, 331–2
betatron A-462a, X-332, *pictures* A-462a
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crystals studied with C-525
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gamma rays distinguished from R-30f–1
gases ionized E-315
high power, development X-331–2
industrial uses X-331
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Van de Graaff generator, *diagram* A-461, *picture* A-461
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Xylem (*zī'lĕm*), woody fiber of trees P-292, *picture* T-179

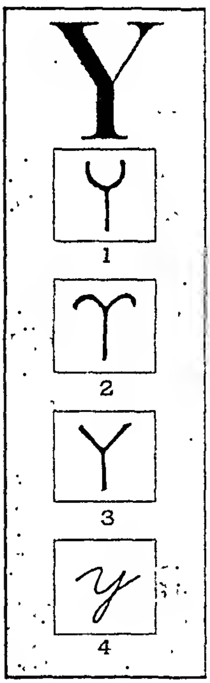
Xylography (*zi-lŏg'ra-fi*), method of block printing B-238

Xylol (*zī'lŏl*), or **xylene** (*zī'lēn*), a coal-tar product C-370–1
solvent for lacquer L-82

Xylophone (*zī'lō-fōn*), musical instrument made of parallel wooden bars, graduated in length, which produce varied tones when struck with small mallets, *picture* M-471

Xylose (*zī'lōs*), or **wood sugar**, a sugarlike substance ($C_5H_{10}O_5$) S-446

'X Y Z' Affair, in U. S. history X-332, A-14



OUR LETTER Y, like F, U, and W, is a child of the oldest alphabetic sign for V. This sign had the value of 'v' or 'w' in all the Semitic alphabets, as told in the Fact-Index article on the letter V.

When the Greeks learned to write from the Phoenicians, they learned the Semitic form of this letter (1). Among the Greeks, various groups used the sign for F, V, U, and W, and the Romans learned these uses when they formed the Latin alphabet, as told in the Fact-Index articles on these letters. For the sign itself, they used the V form which they had learned from the Chalcidian Greek colonists in southern Italy.

After the Romans had conquered the world, however, they learned that the most cultured of all the earlier Greeks, the Athenians, used a letter called *upsilon* for the vowel 'u' (2). Therefore, they commenced to use this sign in a simplified form (3) whenever it occurred in words translated from Athenian, or Attic, Greek. But they could not place it in the Latin alphabet after T, as the Athenians had done with *upsilon*, because in Latin the letter V held this place. The Romans therefore added the new Y after X, the letter which had ended their alphabet up to this time.

From Latin the letter came unchanged into English. But the pronunciation shifted gradually, in later Roman times and even more among the Anglo-Saxons, toward that of 'i', either long or short. Thus in time Y came to be an equivalent of I, as we see by comparing 'strike' with 'try', and 'sill' with 'symbol'. In modern English, the letter sometimes means a special sound, as in 'yacht', 'year'. The small handwritten 'y' (4) is a quickly made variant of the capital, linked with a continuous stroke to the adjoining letters.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Yablonoi (*yä-blō-noi'*) **Mountains**, a system of s. Siberia, extending from s.w. to n.e. 1000 mi. in the direction of the Stanovoi Range; highest point about 8000 ft.

Yabu (*yä'bō*), Afghan horse A-31

Yachts and yachting B-216

Yad'kin River, N. C., rises in Blue Ridge Mts. and flows 300 mi. to South Carolina border; thence called Pee Dee: *maps* N-268, 274
valley, *picture* N-267

Yaghan, or **Yahgan** (*yä'gän*), tribe of Indians in Tierra del Fuego C-254, S-262–3

Yahoos (*yä'hōz*), in Jonathan Swift's 'Gulliver's Travels' S-470, G-229

Yahweh. *See in Index* Jehovah

Yak, a bovine animal of the Himalayas Y-333, *pictures* Y-333, A-402
altitude range, *picture* Z-362
carrying baggage, *picture* E-453
grinding grain, *picture* T-129

Yak'ima, Indian tribe that lives in state of Washington, *table* I-108

Yakima, Wash., industrial city and fruit and farming trade center in s. center; pop. 38,486; canned and dehydrated fruits, lumber, farm machinery, packing-house products: *maps* W-45, U-252

Yakima Valley, Wash., *picture* W-38
hop picking, *picture* W-47

Yakutat (*yäk'ū-tät*), Alaska, village on Yakutat Bay, 150 mi. n.w. of Juneau; pop. 293; naval base: *map* A-135

Yakut (*yä-kōt'*) **Republic**, also Yakutsk, an autonomous republic of Russian Soviet Federated Socialist Republic, in e. Siberia; about 1,160,000 sq. mi.; pop. about 450,000; gold, silver, lead, coal, furs; cap. Yakutsk (pop. 52,888), on Lena River: S-174, *map* R-260

Yakuts, a Turkic tribe of e. Siberia in vicinity of the Lena River R-262

Yale, Elihu (1648–1721), English philanthropist, born Boston, Mass.; founder of Yale College, now Yale University
tapestry made for, *picture* T-14

Yale lock L-289, *picture* L-289

Yale University, at New Haven, Conn.; for men; 2d oldest university in U. S.; chartered 1701 as Collegiate

Key: cāpe, ăt, fär, fȧst, what, fall; mē, yĕt, fērn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, do; cūre, bŭt, rude, fu̇ll, bûrn; out;

universities; authority on spectrum of the sun.
Young, Edward (1683–1765), English poet whose fame rests on his 'The Complaint; or, Night Thoughts on Life, Death, and Immortality', a lofty but gloomy poem, which had great influence in its day and from which have come many proverbial sayings, as "Procrastination is the thief of time."
Young, Ella (born 1867), Irish writer and lecturer; lived among Irish peasants to gather folklore material; came to U.S. 1925 ('The Weird of Finovar', 'The Rose of Heaven', poetry; 'Wonder Smith and His Son', 'Tangle-Coated Horse', folklore; 'Flowering Dusk', autobiography): S-414
Young, Ella Flagg (1845–1918), educator, born Buffalo, N.Y.; superintendent of schools of Chicago, Ill., 1909–15; first woman president of the National Education Association.
Young, Ewing (died 1841), American fur trapper and Oregon pioneer, born eastern Tennessee; trapped from Taos, N. M., about 1824; led party to California 1829; went to Oregon 1834 and settled there
Kit Carson and C-128*a*
Young, Francis Brett (1884–1954), English novelist; practiced medicine for a time; traveled widely; dramatic adventure stories ('My Brother Jonathan'; 'The Redlakes'; 'Mr. and Mrs. Pennington'; 'They Seek a Country'; 'Doctor Bradley Remembers'; 'The City of Gold').
Young, George (1821–1910), Canadian Methodist missionary, born Upper Canada; 1868–84 superintendent of Methodist missions in the West.
Young, Mahonri Mackintosh (born 1877), sculptor and painter, born Salt Lake City, Utah; noted for statues of laborers and western types
monument, Salt Lake City S-31
Young, Owen D. (born 1874), lawyer and businessman, born Van Hornesville, N.Y.; joined General Electric Company 1913 as counsel, board chairman 1922–39 and 1942–44, honorary chairman after 1944; helped to organize Radio Corporation of America and served as executive chairman until 1933; member of first committee of experts inquiring into German reparations and chairman of second commission 1929. *See also in Index* Young Plan
Young, Stark (born 1881), author, born Como, Miss.; served on editorial staff *New Republic* 1921–24, associate editor *Theatre Arts Monthly* 1921–40 ('So Red the Rose'; 'The Pavilion').
Young, Thomas (1773–1829), English physicist and archaeologist; discovered interference of light: L-232–3, P-234
Youngberry, a fruit-bearing vinelike shrub produced by crossing the loganberry and the dewberry; grown on Pacific coast; fruit thimble-shaped, deep purple.
Young Canada's Book Week, celebrated, usually in November, under the sponsorship of the Canadian Library Association; purpose is to encourage the reading of the best books by children at home, at school, and at the library, and to interest adults in the importance of good books for young people.
Young Citizens League, an organization of children of grammar school age; founded in South Dakota in 1912; object "to enable each boy and girl to love and serve his country better, and to become strong of body, alert of mind, and pure of soul."
Young Communists, or Komsomols, organization of Communist youth in Russia R-274, 281–2
Younger Edda, in Scandinavian literature I-11, S-55, M-477
Younghusband, Sir Francis Edward (1863–1942), English soldier, author, and explorer; in youth made exploring trip across China; appointed political agent in India 1890; commissioner to Tibet 1902–4; British resident at Cashmere, India, 1906–9 ('India and Tibet'; 'Wonders of the Himalaya'; 'Epic of Mount Everest'; 'Life in the Stars').
Younghusband, Sir George John (1859–1944), English writer and major general, entered army, 1878; served in Afghan War, Sudan, S. Africa, World War I; keeper of Jewel House, Tower of London, after 1917 ('Tower of London'; 'Crown Jewels of England'; 'Forty Years a Soldier')
quoted on Kipling K-49
Young Italy M-148
Young Men's Christian Association (Y.M.C.A.) Y-341*b*–2, *picture* Y-341*b*
citizenship training C-320
flag F-137, color *picture* F-135
Young Pioneers, Russian Communist organization for children R-274
Young Plan, for reparations to be paid by Germany to Allies W-242, 243
committee, *picture* W-243
Young Pretender P-410
Youngstown, Ohio, large steel center; pop. 168,330: Y-342–3, *maps* O-356, U-253, *picture* Y-342
Youngstown College, at Youngstown, Ohio; chartered 1908; opened 1908; arts and sciences, business administration, engineering, music.
Young Turks, revolutionary party in Turkey.
Young Women's Christian Association (Y.W.C.A.) Y-343
flag F-137, color *picture* F-135
Youth, goddess of, in mythology
Norse, Iduna S-56
Youth Administration, National. *See in Index* National Youth Administration
Youth hostels. *See in Index* Hostels
Youth organizations. *See also table* on next page
adolescence, importance in A-22*a*
Allied Youth, Inc. *See Index* in Vol. A
American Legion A-223
Audubon Junior Clubs A-471
Baptist Young People's Union of America. *See Index* in Vol. B
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Junior Achievement, Inc. *See Index* in Vol. J
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Nazi Germany G-99
New Farmers of America F-326*b*
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Sunday schools S-453–4
Young Citizens League. *See Index* in Vol. Y
Young Men's Christian Association Y-342
Young Women's Christian Association Y-343
Ypres (*ē'pr'*), Flemish Ieper (*yä'pēr*), Belgium, town 35 mi. s. of Ostend, pop. 17,052: Y-343–4, *maps* B-111, W-217, *pictures* Y-344
Flemish trade center B-115
World War I Y-344, W-220, 223, 227
Ypsilanti (*ĭp-sĭ-lăn'tĭ*), **Alexander** (1792–1828), Greek soldier, one of a family famous as leaders in Greek struggle for freedom; in 1821 led unsuccessful insurrection against Turks and was imprisoned in Austria for six years.
Ypsilanti, Mich., city on Huron River 30 mi. s.w. of Detroit; pop. 18,302; automobiles, paper, wooden ladders, stoves; foundries and machine shops; Michigan State Normal College; Willow Run nearby: *map* M-227
Ysaye (*ē-zä'yü*), **Eugène** (1858–1931), Belgian violinist, composer, and orchestra conductor; many concert tours in U.S.; conducted Cincinnati Symphony Orchestra for several years.
Yser (*ē-zēr'*) **River**, French and Belgian river rising 20 mi. s.e. of Calais, France, and flowing e. and n. to sea at Nieuport, Belgium; important in medieval trade; in World War I battle, Oct. 16–28, 1914, Belgians halted German advance by cutting dikes and turning country into a lake.
Ysleta, Tex., also **Isleta** (*ĭs-lē'ta*), village on Rio Grande, 12 mi. s.e. of El Paso; pop. 4782; a former Tigua pueblo: *map, inset* T-91
Yssel Lake, Netherlands. *See in Index* Zuider Zee
Ytterbium (*ĭ-tẽr'bĭ-ŭm*), a chemical element, *tables* P-151, C-214
Yttrium (*ĭt'rĭ-ŭm*), a rare chemical element, discovered 1842; belongs to rare earth group: *tables* P-151, C-214
Yturbide, or Iturbide (*ē-tṳr-vē'thā*), **Augustin de** (1783–1824), emperor of Mexico M-206
Yuan (*yṳ-än'*), since 1928 any one of the 4 departments (executive, legislative, judicial, control) in National, or Kuomintang, government of China—for example, "executive yuan."
Yuan, monetary unit of China C-273
Yuan Dynasty, or Mongol Dynasty, in China (1280–1367) M-345, C-279
Yuan Shih-kai (*yü-än' shĭr'kī'*) (1859–1916), Chinese soldier and statesman, president of the Chinese

YOUTH-SERVING ORGANIZATIONS

Young Adult Council was organized in May 1948. It is composed of 14 major youth organizations, each of which has representatives and one adult adviser on the council. The member organizations are:

- American Red Cross, College Units
- American Unitarian Youth
- American Youth Hostels
- Collegiate Council for the United Nations
- National Association for the Advancement of Colored People, Youth Division
- National Catholic Welfare Conference, Youth Department
- National Federation of Settlements
- National Jewish Youth Conference
- North American Student Cooperative League
- United Christian Youth Movement
- United World Federalists, Student Division
- Universalist Youth Fellowship
- Young Men's Christian Association, National Council
- Young Women's Christian Association, National Board

Agricultural and Rural Life Organizations

	Year Founded
American Country Life Association	1919
American Farm Bureau Federation	1919
4-H Clubs	1907
Future Farmers of America	1928
Future Homemakers of America	1945
National Committee on Boys and Girls Club Work	1921
National Grange	1867
New Farmers of America	1927
New Homemakers of America, Inc	1945

Catholic Organizations Serving Youth

Catholic Boys' Brigade of the United States	1915
Catholic Students' Mission Crusade, U.S.A	1918
Christ Child Society	1886
International Federation of Catholic Alumnae	1914
Junior Catholic Daughters of America	1926
Knights of Columbus, Boy Life Bureau (Columbian Squires)	1925
National Federation of Catholic College Students of the United States	1937
Neuman Club Federation	1915
Sodality of Our Lady	1583

General Character-Building Organizations for Youth

American Junior Red Cross	1917
American Youth Foundation	1924
Boy Rangers of America	1913
Boy Scouts of America	1910
Boys' Clubs of America	1906
Camp Fire Girls	1910
De Molay, Grand Council of the Order of	1919
Girl Scouts	1912
Junior Achievement	1919
National Self-Government Committee	1904
Order of the Rainbow for Girls	1922
Pathfinders of America	1914
Young Men's Christian Association	1866
Young Women's Christian Association	1906

Jewish Organizations Serving Young

	Year Founded
B'nai B'rith Hillel Foundations	1923
B'nai B'rith Vocational Service Bureau	1938
B'nai B'rith Youth Organization	1924
Council of Jewish Federations and Welfare Funds	1932
Habonim: Labor Zionist Youth	1920
Intercollegiate Zionist Federation of America	1945
Jewish Agricultural Society	1900
Jewish Occupational Council	1938
Junior Hadassah	1920
Masada, Youth Zionist Organization of America	1933
National Council of Jewish Juniors	1919
National Council of Young Israel	1912
National Federation of Temple Youth	1939
National Jewish Welfare Board	1913
Young Judaea	1909
Young People's League of the United Synagogue of America	1921

Protestant Religious Youth-Serving Organizations

American Friends Service Committee	1917
American Unitarian Youth	1896
Brotherhood of St. Andrew in the United States	1883
Congregational and Christian Churches, Division of Christian Education	1816
Federal Council of Churches of Christ in America	1908
Girls' Friendly Society of the U.S.A.	1877
International Council of Religious Education	1922
International Order of the King's Daughters and Sons	1886
International Society of Christian Endeavor	1881
International Walther League	1893
Luther League of America	1895
Methodist Youth Fellowship	1889
National Protestant Council on Higher Education	1911
Order of Sir Galahad	1896
Pi Christian Fraternal Orders	1905
Protestant Episcopal Church, Department of Christian Social Relations	1919
Protestant Episcopal Church, Youth Division	1925
Student Volunteer Movement	1888
United Christian Youth Movement	1931
Youth Fellowship of the Reformed Church in America	1933

Student Associations

American Red Cross College Units	1942
American Youth for Democracy	1943
National Association of Student Councils	1930
National Honor Society of Secondary Schools	1921
National Junior Honor Society	1929
North American Student Cooperative League	1946
Student Division, United World Federalists	1942
Student League for Industrial Democracy	1905
Students for Democratic Action—Student Division of Americans for Democratic Action	1943
United Student Christian Council	1944

istence of subatomic particle, the meson; professor at Kyoto University since 1939; to U.S. 1948; worked at Institute for Advanced Study at Princeton, N.J.; visiting professor, Columbia University, 1949–50; received 1949 Nobel prize in physics for predicting the meson.

Yukon (*yṳ'kŏn*), important river of Canada and Alaska Y-348, *maps* A-135, C-68, 80, N-245, 250, *picture* N-255
joint United States-Canada use agreed on C-100

Yukon Flats Y-348

Yukon Territory, Canada, most northwesterly political division of Canada 207,076 sq. mi.; pop. 9096; cap. White Horse; gold fields: Y-348, *maps* C-68, 80
Klondike K-55

Yule, or **Jol**, name of a winter month in northern Europe C-299

Yule log C-299, 294*b*, 295, 296, 297

Yu'ma ("son of the captain"), chief tribe of Yuman stock of North American Indians; lived originally about confluence of Gila and Colorado rivers.

Yuma, Ariz., city in s.w. on Colorado River at mouth of Gila, in agricultural region; pop. 9145: *maps* A-353, U-252
climate A-344
irrigation project A-346

Yu'man, a linguistic stock of North American Indians, living in California, Arizona, and Lower California; agricultural rather than hunting people.

Yuncas (*yọng'kạz*), ancient tribe of South American Indians having a finely organized civilization
capital city, *picture* A-301

Yungas, forested regions in South America S-270
Bolivia B-222*a*

Yungki, Manchuria. *See in Index* Kirin, city

Yunnan (*yṳ-năn'*), s.w. province of China; 123,572 sq. mi.; pop. 9,171,449; rich copper mines; exports tin; cap. Yunnan, or Kunming: *map* C-260

Yupon. *See in Index* Yaupon

Yurev, Estonia. *See in Index* Tartu

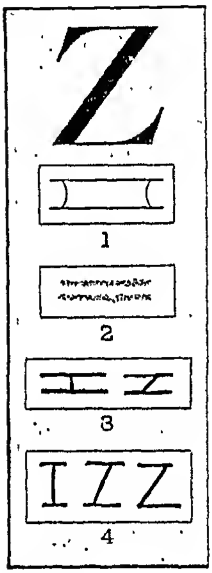
Yurok, Indian tribe living on lower Klamath River and adjacent coast in California.

Yurt, a type of tent A-415, *pictures* M-341, 342
interior, *picture* M-344

Yuste (*yọs'tā*), Spain, monastery in w. center near Plasencia
Charles V retires to C-190

Yusuf ibn Ayyub (*yọ'sụf ĭ'b'n ĭ'yọb*), original name of Saladin S-25

Y.W.C.A. *See in Index* Young Women's Christian Association



OUR LETTER Z probably started in Egypt as a sign which meant 'pool of water' (1). Soon after 2000 B.C., a Semitic people called the Seirites adopted it as an alphabetic sign for the sound of 'z'. Probably they did this because the horizontal lines of the Egyptian sign looked to them like two sticks. Since they called such sticks *zain* or *zayin*, the sign made a good symbol for the sound of 'z'.

The Seirites made the sign simply with two lines (2). The later Canaanite-Phoenician alphabet used a sign (3) more like the Egyptian picture. In Hebrew the sign was called *zayin;* other Semitic languages had similar names. In all Semitic alphabets, it stood in the seventh place, where the English alphabet places 'g'.

When the Greeks learned to write from the Semitic Phoenicians, they refined the sign (4) and called it *zeta* (pronounced *zayta*). The early Romans did not use the 'z' sound in their speech, and they gave a new sign the place of *zeta* in the alphabet, as told in the Fact-Index article on G.

After the Romans had conquered the Western World and become interested in Greek literature, they wanted to write the Greek 'z' in Latin. But its place in their alphabet had been given to G, and so they added it at the end. The English alphabet too, like the late Latin from which it came, ends with Z.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Zabrze, Poland. *See in Index* Hindenburg

Zacatecas (*sä-kä-tā'käs*), state in central Mexico; 28,122 sq. mi.; pop. 661,846; cap. Zacatecas; silver: *map* M-194, *picture* M-191

Zacatecas, Mexico, capital of state of Zacatecas, 350 mi. n.w. of Mexico City; pop. 23,576: *maps* M-189, 194

Zacharias, or **Zachary**, **Saint** (died 752), pope (741–752) of Greek birth; took an active part in French and German affairs; commemorated as saint March 13.

Zadar, Yugoslavia. *See in Index* Zara

Zadkine (*zäd'kēn*), **Ossip** (born 1890), Polish painter and sculptor; lived chiefly in England and France; distinguished for work in abstract and geometric forms: S-82

Zadru'gas, community groups of related families, in Balkans S-103

Zaehnsdorf, Joseph (1816–86), English bookbinder, born Austria-Hungary; became English citizen 1855; one of the foremost commercial binders of the 19th century.

Zagreb (*zä'grĕb*), or **Agram** (*ä'gräm*), Yugoslavia, city 80 mi. n.e. of Fiume; formerly capital of Croatia-Slavonia; pop. 350,452; linen, carpets, leather; university: *maps* E-416, 425, B-23

Zagros (*zä'grōs*) **Mountains**, series of parallel ranges in w. Iran; highest elevation about 12,850 ft.; general height of ridge crests 8000 ft.: *maps* I-224, A-285

Zaharias (*zä-hä-rī'ạs*), **Mildred Didrikson (Babe)** (born 1913), athlete, born Port Arthur, Tex.; All-American forward in women's basketball; broke world records for women in javelin throw and 80-meter hurdles in Olympic Games 1932; since 1934, won the women's major golf titles; amazing knack for many other sports; in Associated Press poll, 1950, she was voted greatest woman athlete of first half of 20th century.

Zaharov, Sir Basil Zachariah (1850–1936), international financier, born Phanaz, Turkey; his mother was a Greek, his father a Russian; as financial backer of European munition makers, was influential in international affairs during Balkan wars and World War I.

Zahir Shah. *See in Index* Mohammed Zahir Shah

Zaibatsu, commercial companies, Japan J-308, 320
broken up J-309

Zaïmis (*zä'ē-mēs*), **Alexander** (1855–1936), Greek statesman, six times premier; president 1929–35.

Zaluski (*zä-lọs'kĭ*) **family**, an influential family of Poland; **Andrew Chrysostom** (1650–1711), bishop and orator; **Joseph Andrew** (1702–74), bishop, collector of books and manuscripts: L-183

Zaluzianskya (*zăl-ū-zĭ-ăn'skĭ-ạ*), a genus of annual and perennial plants of the figwort family, native to South Africa. One species grows to one ft.; flowers, in flat clusters, are deeply cut like snow crystals, white or lilac inside, with orange eye at center, purple outside; stems hairy; sometimes called lace verbena or night phlox; fragrant in evening.

Za'ma, battle of (202 B.C.) H-260

Zambezi (*zăm-bē'zĭ*) **River**, 4th largest river of Africa Z-349, *maps* A-42, 47, S-242, E-199
Victoria Falls V-470–1, *picture* V-470

Zamboanga (*säm-bō-äng'gä*), Philippine Islands, city on island of Mindanao; capital of province of Zamboanga; port and market for timber, abaca, copra, hemp; settled by Spanish 1635; pop. 17,001: *maps* P-195, P-16

Zamenhov (*zä'mĕn-hôf*), **Lazarus Ludwig** (1859–1917), Russian philologist, inventor of Esperanto E-397

Zamora, Niceto Alcalá. *See in Index* Alcalá Zamora

Zorndorf (*tsôrn'dôrf*), Poland, former Prussian village 53 mi. n.e. of Berlin, Germany; victory of Frederick the Great over the Russians under Fermor (Aug. 25, 1758); included in Poland since 1945.

Zoroaster (*zō-rō-ăs'tẽr*), or **Zarathus'tra**, Persian teacher, founder of Zoroastrianism Z-365–6, P-155, 157
 Parsees descendants of followers B-225

Zorrilla (*thôr-rē'lyä*), **José** (1817–93), Spanish poet and dramatist; won popular esteem by his versification of old Spanish legends and later with his plays, but spent greater part of his life in dire poverty; crowned national laureate, 1889 ('Cantos del trovador', legends; 'Don Juan Tenorio', drama; 'Granada', unfinished epic).

Zoser. *See in Index* Djoser

Zoshchenko (*zōs'chĕn-kō*), **Mikhail** (born 1895), Russian humorist and short-story writer, born Poltava, Russia (collections of stories: 'Russia Laughs', 'The Woman Who Could Not Read', and 'Respected Citizens'): R-295

Zouave (*zo̤-äv'*), French infantry corps originally recruited in Algeria from the Zouaves, a tribe of Berbers, but now drawn from France; wear picturesque Oriental uniform.

'ZRS-4' (*Akron*) and **'ZRS-5'** (*Macon*), U.S. Navy airships B-34

Zsigmondy (*zhĭg'mōn-dē*), **Richard** (1865–1929), German chemist, born Vienna, Austria; with Henry Siedentopf designed ultramicroscope 1903; for research in colloids won 1925 Nobel prize in chemistry.

Zucchini (*zo̤-kē'nē*), a cylindrical, sometimes curved, summer squash; plant bushy; flesh thick and tender.

Zugspitze (*tsṳk'shpit-sĕ*), highest peak in Germany (9719 ft.) G-89

Zuider Zee (*zī'dẽr zē*, Dutch *zoi'dẽr zā*), formerly an arm of North Sea extending s. into Netherlands; now known as Ijssel or Yssel (*ī'sĕl*) Lake since completion of dam in 1932 cutting it off from North Sea: N-114, *maps* B-111, E-424
 reclamation project, *pictures* I-253, N-118

Zuloaga (*tho̤-lō-ä'gä*), **Ignacio** (1870–1945), Spanish painter; striking and truthful portraits and virile figure paintings of dancers, gypsies, bullfighters; original composition and mellow and harmonious color; greatly influenced by impressionists.

Zu'lu, Negro people, Bantu-speaking; live in Zululand: *color pictures* A-35, 38

Zululand, former province, now a territory of Natal, Union of South Africa; 10,427 sq. mi.; pop. 398,460, including 386,633 natives
 white rhinoceros R-134, *picture* R-134
 black rhinoceros, *color picture* A-36

Zuñi (*zo̤'nyē*), tribe of Pueblo Indians living in New Mexico P-431, *map* I-106*f*, *table* I-108
 cooking C-463
 Marcos de Niza and A-346
 Seven Cities of Cibola C-486

Zuni, N.M., Pueblo Indian village on Zuni River, near w. boundary of state; pop. 2563; Pueblo customs and religion still retained; basketry, weaving, pottery, turquoise jewelry: *map* N-178

Zuppke, Robert Carl (born 1879), American football coach and director of physical education, born Berlin, Germany; graduated, University of Wisconsin, 1905; director, school athletics, Muskegon, Mich., 1906–10, Oak Park, Ill., 1910–13; head football coach and professor of physical education, University of Illinois, 1913–41: F-232

Zurbarán (*thor-bä-rän'*), **Francisco de** (1598?–1664), Spanish painter of religious subjects and portraits; held title of painter to the king; ('The Crucifixion'; 'Apotheosis of St. Thomas Aquinas'; 'St. Francis of Assisi').

Zurich (*zṳ'rĭk*, German *tso̤-rĭκ*), largest city of Switzerland; pop. 390,020: Z-366, *maps* S-475, E-416, 425

Zurich, Lake, Swiss lake chiefly in s. part of canton of Zurich; 34 sq. mi.; city of Zurich at n. end: S-475, *map* S-475

Zurich, Treaty of. *See in Index* Treaties, *table*

Zutphen (*zŭt'fĕn*), Netherlands, town in s.e., several times taken and sacked; pop. 21,714; Sir Philip Sidney killed at battle of (1586).

Zweig (*tsvīκ*), **Arnold** (born 1887), German author; after winning fame in Germany for his short stories and a successful drama, 'Ritual Murder in Hungary', came to international attention with 'The Case of Sergeant Grischa', one of ablest and most significant novels of World War I; exile from Germany after rise of Nazis; emigrated to Palestine in 1934.

Zweig, Stefan (1881–1942), Austrian critic, poet, dramatist, and translator ('Jeremiah', antiwar tragedy; 'Romain Rolland', 'Paul Verlaine', 'Adepts at Self-Portraiture', and 'Mary of Scotland', critical and biographical studies; 'Beware of Pity', novel); exile from Austria after 1933; committed suicide in Brazil.

Zwickau (*tsvĭk'ou*), Germany, manufacturing city of Saxony, 60 mi. s.w. of Dresden on Mulde River; pop. 122,862; old churches; coal fields; birthplace of Robert Schumann: *map* E-425

Zwinger (*tsvĭng'ẽr*) **Museum**, art gallery, Dresden, Germany D-143

Zwingli (*tsvĭng'lĭ*), **Ulrich** (1484–1531), Swiss Protestant reformer Z-366, R-92

Zwolle (*zvōl'lŭ*), Netherlands, capital of province of Overÿssel, 60 mi. n.e. of Amsterdam; pop. 47,462; center of n. and e. canal systems; cotton, iron, ships; cattle and fish market; nearby, Thomas à Kempis lived and died: *maps* B-111, E-424

Zworykin, Vladimir Kosma (born 1889), American radio and television engineer, born Russia; came to U.S. 1919, became a citizen 1924; with Radio Corporation of America since 1929; developed the iconoscope ('Photocells and Their Applications'; 'Television'): T-54*d*

Zygomatic process, a prolongation of the temporal bone which supports the malar (cheek) bone: S-192

Zygophyllaceae. *See in Index* Caltrop family

Zygote (*zī'gōt*), in biology, cell formed by union of male and female gametes; a fertilized egg cell: S-356

Zymase (*zī'măs*), a ferment found in yeast E-389

ṳ=French *u*, German ü; ġem, ḡo; thin, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); κ=German guttural *ch*